

December 5, 1960

# Aviation Week

## and Space Technology

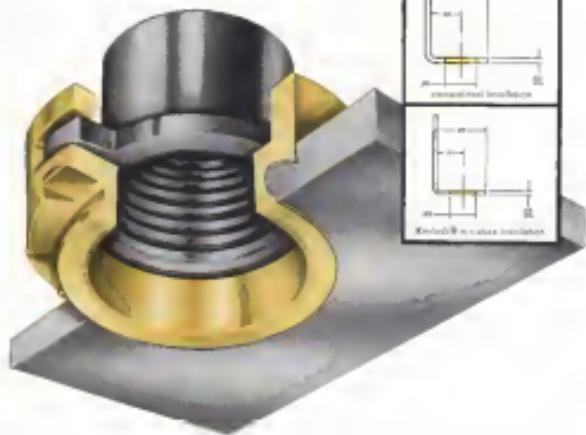
75 Cents

A McGraw-Hill Publication

Special Report  
On German  
Industry



Bell D-188A V/STOL Mockup



### No mistaking Kaynar's new stake nut—it's miniaturized.

The new Kaylock® Miniature Stake Nuts bear the unmistakable mark of Kaynar's leadership in aerospace fastener weight and space savings. These new innovations answer the critical need for installed reliability of threaded elements in minimum thickness materials... can save you up to 30% of hardware weight. Additional savings can accrue as a result of thinner parent material requirements (.088 maximum thickness for Kaylock Non-Flanging Stake Nuts, .048 maximum for Flanging Stake Nuts).

**Easy and Quicker to Install!** No burring of the nut shank is required. The pressure and in installation results in a cold flow of the parent material. The interlock of the nut and the mating material, in a smaller installation hole, provides greater structural integrity. Staking action of the Kaylock self-locking nut provides maximum retention against pull-out and torque-out. The new series is available in miniature and regular configurations, both flanging and no-flanging. Write today for the new Kaylock Stake Nut Brochure, or contact your Kaynar representative.

**Kaylock**  
heat insulation features

KAYNAR MFG. CO., INC., KAYLOCK DIVISION  
Box 2004, Terminal Annex, Los Angeles, Calif. 90045  
Worthington & Concourse, 100 W. 14th Street, New York, N.Y.  
Atlanta, Ga.; Kansas City, Missouri; Paris, France; London, England

MF 2000 Flying division

MF 2500 Manufacturing division



### GROUND SUPPORT EQUIPMENT: another prime capability of Goodyear Aircraft



1. Control Room—new concept for universal test equipment for aircraft, aircraft or field.



2. Portable Inspection Station "Mobile" which holds up to 1000 lbs. of mobile equipment air systems.



3. Concentration Hydrant on trailer. Light weight, compact, easy to move rapidly to concentrated point.



4. Portable Power Pack consists of two units—5 kilowatt power generator and fuel system.



5. Mobile Axle Sealing Work—centrally reduces maintenance required of ground facilities.

### Standardizing G.S.E. It's Standard Operating Procedure at GAC

**Procedure at GAC.** Design philosophy which leads on reducing the number of units to meet the support requirements for each new system is Standard Operating Procedure at Goodyear Aircraft. Shown here are examples of GAC built ground support equipment which benefits from this standardization approach. Details on the requirements are, perhaps, not been discussed to perform the functions of many units. If you are interested in reducing the problems of logistics on your GSE requirements, let us find the common denominator with Goodyear Aircraft Corporation, Dept. 915A, Akron 15, Ohio or Litchfield Park, Arizona.

Lots of good things come from

**GOOD**  **YEAR**  
**AIRCRAFT**

Product of 2  
American systems air force

ARMED  
FORCES

MANUFACTURING  
MANAGEMENT



Five European NATO nations will produce the U. S. Army Hawk missile as the primary ground-to-air defense weapon in Western Europe. Raytheon, developer and prime contractor in the U.S. for the Hawk, is supplying technical assistance to manufacturers selected by these NATO countries.

## RAYTHEON COMPANY



WALTERS: 電子報名單與電子郵件

基础科学与工程系 机械系 电气系 信息系

## AVIATION CALENDAR

Dec 12-15—Montana Institute, Kalispell  
Columbia Mountain Mountain Lodge  
See FRISCO page 10

Dec 15-19—Tenth Annual Entomological Congress Conference Hotel New York and  
New Jersey Convention Center, New York City  
See NEW YORK page 10

Dec 16-19—National Pest Management Association Annual Meeting Hotel D'Angleterre  
Long Beach, Calif. See LONG BEACH page 10

Dec 16-19—Conviviale Annual Congress  
Grand Concourse Hotel, Bronx, N.Y.  
See NEW YORK page 10

Dec 17-23—Wright Brothers Lecture  
National Union Building, Washington, D.C.  
See WASHINGTON page 10

Dec 26-31—127th Meeting, American Association for the Advancement of Science  
New York, N.Y.  
See 20-30—Annual Eng. Design Technol.  
Meeting, First Vice President, See  
9-13—Second National Symposium on  
Reliability and Quality Control, Ball  
Research Institute Philadelphia, Pa.  
See 9-13—International Congress and Exposition  
Society of Automotive Engineers, Cobo Hall, Detroit, Mich.  
See 14-18—Annual Convention, American  
League of American Chew Hill Inn  
Highland Park, Ill.

Jan 16-18—Fifteenth Annual National Meeting  
American Association of Science, D.C.  
See 16-18

Jan 27-30—Winter Instrument Automation  
Meeting, Exhibit International, Interna-  
tional City of America, Buffalo Hotel and Racetrack  
Buffalo, N.Y. See 27-30

Jan 28-29—Annual Meeting, Institute  
of the Acoustical Sciences, Hotel Astor  
New York, N.Y.

(Cancelled on page 6)

ANNUAL REPORT AND STATEMENT

December 3, 1960

Particular, Please send form 102 to Fulbright Commission.

SEARCHED INDEXED DECEMBER 3, 1966

Long  
Before  
Countdown...

Throughout assembly and long before  
Countdown, special purpose computers and Test  
Stations compare performance to preset limits.  
High speed printers convert digital output into  
intelligence which can be used for analysis of  
design and performance characteristics.

Autelx Corporation has earned a place in this program with the recognized reliability of its High Speed Printers, and Autelx Systems Division is qualified, by ten years as an engineering team, to design the specialized software required to bring data source information to the Printer in a form it can use. This and other expertise in the application of digital techniques enables Autelx engineers to solve many specific problems arising from new military and industrial developments.



for further information, write or telephone

## ANELEX CORPORATION

1801 CAYERWAY ST., BOSTON 34, MASS.





SOMETHING NEW  
UNDER THE STARS

**The one helicopter FAA-certified for instrument flight: Cessna CH-1C** First helicopter to meet the exacting IFR requirements of FAA, the CH-1C is practical not only for what it does but for how it does it. Through clean configuration—plus its simple mechanical stabilizers—the CH-1C combines low initial cost, low operating cost, ease of operation. New helicopter instrument training and all-visibility lenses at last can be considered economical.



World's most experienced makers of utility military aircraft

AVIATION CALENDAR

(Continued from page 5)

New York, N.Y. (Inter) Night Convener, Jan. 24  
Feb. 1-Louisiana Writers' Meeting, Bayou Conference, University of Baton Rouge, Baton Rouge Hotel, La. (Anglo)  
Feb. 1-Louisiana Proprietary Conference, American Society Survey, Salt Lake City  
Feb. 15-17-International Solid-State Circuits Conference, members of Radio Electronics, Solid State, and Photoelectric Manufacturers Association, Los Angeles, Calif.  
Mar. 1-Voluntary Action Con. Victoria, Can. (Kerner and Pfeiffer, American Society of Voluntary Engineers, Shoshone Hotel, Washington, D.C.)  
Mar. 8-10-Second Symposium on Engineering Aspects of Microelectromechanics, University of Michigan, Ann Arbor, Mich.  
Mar. 10-12-Flight Propulsion Meeting, Institute of the Aerospace Sciences, Cleveland, Ohio (Abraamoff)  
Mar. 12-16-Annual Conference, American Society of Mechanical Engineers, Statler Hilton, Los Angeles, Calif.  
Mar. 14-18-Flight Testing Conference, American Rocket Society, Los Angeles  
Mar. 15-16-Fire, Operation and Support Conference, American Rocket Society, Biltmore Hotel, Los Angeles, Calif.  
Mar. 26-28-19th National Conference on Aviation Electronics, Marlowe Hotel, New Haven, Conn.  
Mar. 29-31-International Conference, Institute of Radio Engineers, Coliseum and Waldorf Astoria Hotel, New York, N.Y.  
Mar. 28-29-1961 Meeting, Vital Experiments American Society for Micros Prog. Pacific, American, Los Angeles, Calif.  
Apr. 1-4-International Conference on Electronics and Their Diversity of Functions, Polytechnic Institute of Brooklyn, Brooklyn, N.Y.  
Apr. 5-7-Lifting Heavy Vehicles, Rose Inn, Morris & Demas, American Society of Mechanical Engineers, Englewood, Colo.  
Apr. 7-11-1st Technical Conference International Air Transport Area, Queen Elizabeth Hotel, Montreal, Canada  
Apr. 18-20-Symposium on Chemical Reactions in the Liquid and Upper Atmosphere, Meteor Research Institute, Starkweather Hall, Los Angeles, Calif.  
Apr. 20-22-Growth Meeting, American Meteorological Society, with the American Geophysical Union, Washington, D.C.  
Apr. 26-28-Regional Rocket Propulsion and Guidance Conference, American Rocket Society, Long Beach, Calif.  
Apr. 28-May 1-International Meeting, Sociedad Espanola de Aviacion y Astronautica, Madrid, Spain  
May 1-10-National Standardization Institute Conference, Institute of Radio Engineers, New York, N.Y.  
May 11-12-Written Test, Computer Con. Service, and U.S. Test Institute, Hotel, Los Angeles, Calif.  
May 12-14-National Thermodynamics Conference, Institute of Physics, London, England  
May 16-June 4-1961 People International, New York, Lausanne, Paris, France  
Sept. 4-10-1961 Flying Display and Fights, New Series of British Aircraft Convair, Farnborough, England



## Raytheon Fire Control Radar System installed in newest missile destroyer

Raytheon AN/SPG-51 fire control radar are operational aboard the U.S.S. CHARLES F. ADAMS (DDG 2). As the Mark 74 Fire Control System Coordinator for the Bureau of Naval Weapons, Raytheon is carrying out serial production of the advanced design AN/SPG-51.

The ADAMS first destroyer built from the keel up to launch guided missiles, carries out the Anti-Air Warfare mission on the TARTAR surface to shore missiles. The radar tracks intruders and guides the missiles even to low altitude targets despite the use of evasive tactics or electronic countermeasures.

Each AN/SPG-51 consists of a single dish tracking and guidance radar. The radar tracks at long ranges with exceptionally low power.

Upon acquisition, AN/SPG-51 automatically acquires and tracks the target. Seconds before missile launch, the target is discriminated with a guidance beam. The missile issues on the reflected signal.

The AN/SPG-51 features excellent anti-clutter capability and exceptional techniques to resist jamming. Selected for the Bureau of Naval Weapons for guided missile applications, this is the first fire control radar of its type to be procured in quantity.

**RAYTHEON**

**RAYTHEON COMPANY**

EQUIPMENT DIVISION



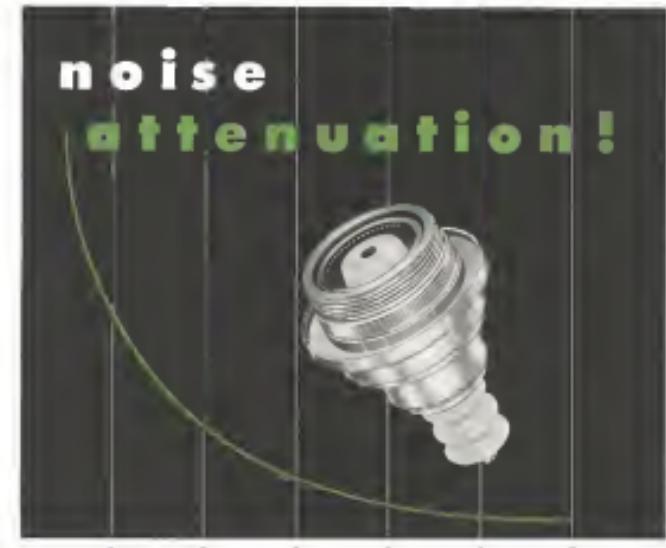
## BRUNSWICK OFFERS COMPLETE CAPABILITY FOR AEROSPACE PROJECTS

"Complete capability" sums up Brunswick's ability to produce results at any stage of missile development. From in-house design and production to thorough testing, Brunswick brings to each new job a vast background in successful development of components and primary structures. 1. In new cones and reentries, Brunswick designs and materials can be tailored to meet rigorous new requirements for high temperature electrical and ablation purposes. 2. In wings and fins, Brunswick engineering allows new plastic structures and antennas utilized in conjunction for more de-

sign freedom with maximum efficiency. 3. Missile bodies constructed by the Strickland "B" fiber glass filament-winding process offer exceptional values in weight-strength ratios while meeting design requirements for unusual shapes and sizes. 4. Brunswick rocket motor cases constructed by the Strickland "B" fiber glass filament-winding process consistently demonstrate superior properties, whether large or small. Pressure vessels designed by Brunswick can deliver an S/D ratio as high as 2,000,000. 5. Reflectors of metal honeycomb or plastic construction are designed and man-

ufactured to meet close tolerances and conform to the highest standards of quality and performance. 6. Strand radomes are readily available for ground support applications. Constructed of solid laminate, honeycomb core, or fabric, they are standard production design at Brunswick. From the starting line, or at any stage of the development process, Brunswick's complete capability is ready to make your ideas work faster and better. Call on Brunswick's ability to produce results. Brunswick Corporation, Defense Products Division, 1700 Meader Street, Muskegon, Michigan.

**B** **Brunswick**  
AEROSPACE PRODUCTS DIVISION • 1700 MEADER STREET • MUSKEGON, MICHIGAN



## Double-shielded TRIAXIAL connectors for hi-current, pulsed circuit cable assemblies



Available... general ratings through 15 kV d.c. or 25 kV pulsed d.c. Performance tested at  $-50^{\circ}\text{C}$  under conditions of humidity, shock, vibration and air spray without functional impairment. Bulkhead pressure-tested to without 75 psi.

Available... Air to Air and Air to Oil RECEPTACLES • Right Angle RECEPTACLES • Double end ADAPTERS • Field assembled and Mated to Cable PLUGS • Mated/receptacle CAP

OTHER CONNECTORS FOR CABLE ASSEMBLIES: TRIAXIAL • H Connectors, Low Voltage, Attenuated Noise Radiation • GENERAL • HI-POT, Low-Capacitance, Cross Pin • STANDARD INSULATED TYPES • SPECIAL CABLE ASSEMBLIES

Above data is peak in research no static assembly noise and current problems.  
For literature write:

**H. H. BUGGIE  
FACILITY**

**BURNDY**

OMATON DIVISION • P. O. BOX 817, TOLEDO 1, OHIO



AN ACHIEVEMENT IN DEFENSE ELECTRONICS



## 412L Strengthens Air Defense By Integrating Airspace Management

Rapid coordination of all phases of military aerospace management is a major problem of air defense. This simulated operations room depicts the heart of the Air Force's 412L Air Weapons Control System—an angle, semi-automatic electronic complex which coordinates radar stations, data processing and display centers and weapons bases into a unified network.

Within seconds, 412L will provide the vital detection and tracking data to human decision makers. Precious time will be gained since com-

tations leading up to the final decisions will be done automatically. In addition, 412L is a highly flexible system designed for use throughout the Free World. It will operate in mobile as well as fixed environments.

Currently going into preflight production, 412L has already anticipated technological advances. And, importantly, new equipment can be integrated into this versatile Air Weapons Control System in the future, making a complex which will remain combat-ready for many years.

ARMED FORCES ELECTRONICS  
DEFENSE ELECTRONICS DIVISION • SYRACUSE, NEW YORK

Progress Is Our Most Important Product

GENERAL ELECTRIC



## BETTER, CLEANER, MORE WORKABLE STEELS through A-L Vacuum Melting Techniques



Microstructure of Trilobed A-286 showing Ti compound strings in A-L Mett (bottom) and absence of such strings in Vacuum Mett (top).

*What you can expect from A-L's Consutrode,  
Invac, and Invacutrode steels and alloys.*

If you have really critical applications, you need A-L's Consutrode, Invac, and Invacutrode steels and alloys, products of unique vacuum melting operations. These alloys provide a combination of improved metallurgical and mechanical properties. They give you the assurance in complex high-temperature missile and aircraft applications... provide the finest bearing steels, low alloy steels, stainless steels, tool steels... meet the most critical applications... withstand the worse service conditions.

Here are a few of the specific advantages you get in A-L's vacuum melted materials:

- ✓ Higher mechanical properties—fatigue strength, transverse ductility, strength
- ✓ Improved cleanliness and decreased gas content
- ✓ Better hot and cold workability
- ✓ Higher Reliability—Extended Life
- ✓ Fewer Rejections—Decreased Part Cost

A-L's modern melting techniques can be applied to help solve your problems. And these vacuum melted steels are in regular production, available now in all commercial mill forms and sizes.

For further information on A-L's modern melting techniques and the advantages of Consutrode, Invac, and Invacutrode alloys, get the new booklet, "Modern Melting at Allegheny Ludlum." It's packed with engineering data. Ask your nearest A-L sales office for a copy, or write Allegheny Ludlum Steel Corporation, Oliver Building, Pittsburgh 22, Pennsylvania. Address Dept. SW-12.

NEW TELEMETRY TECHNIQUE:



# PCM ON A SUBCARRIER

Compatible with existing FM FM systems. Digital modulation of subcarrier provides increased accuracy and rapid data reduction capabilities. Up to 10 bits transmitted on a 70 KC subcarrier. Subcarriers and Discriminators to 300 KC available for increased frequency response. VECTOR Manufacturing Company Inc., Southampton, Pennsylvania.



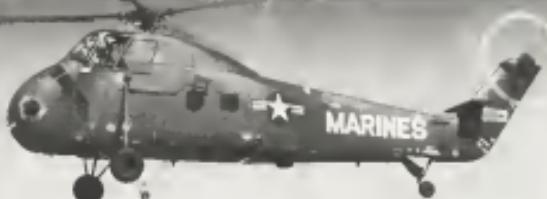
**ALLEGHENY LUDLUM**  
PIONEERING on the Horizons of Steel



TELEMETRY COMPONENTS AND SYSTEMS

*Fly it...Float it...Pull it...*

# CONDEC



#### Unitized, air-conditioned mobile shelters

Types of Condec mobile shelter are those air-conditioned vans which can be joined at building-block. It starts to provide any desired floor area. Transportable by land, sea and air, they provide comfortable working conditions from the Arctic to the tropics.

Friend has an electric workshop shown here, they weigh less than 3,000 pounds. Equipment installed includes workbenches, instrument cabinets, refrigerators for 100,000 cubic feet, 480 cycle AC and 25-volt DC, fluorescent lighting, emergency battery lighting, air-conditioning and heating.

The distinctive, sloping undercarriage designed by **AVIATIK EQUIPMENT** Drama engineers adds a new dimension to the word "mobile". For loading in stages planes, our truck eliminates the body to platform height, four quarter-length hydraulic jacks adjust body floor running gear, ready to be lowered should "Wheels" become flat, brakes are automatically applied. What to know how **COUSINE** can help you with your mobile trailer requirements? Call or write **Mr. JAMES D. DAVIS**, Vice President, Aircraft Equipment Division.

## Condec Products for Missiles and Aircraft

Special purpose vehicles,  
like the 100-tonne truck for  
the key personnel of  
(construction) forces  
from 400-6000 people, will  
provide maximum mobility  
and rapid response of military  
units.



Test acquiescent  
co-verbale, indiqué  
dans le tableau  
synthèse magnétique,  
électrique et magnéto-  
électrique.



Several software drivers  
include features like this  
menu to set up a particular  
device and copy weight  
data, shown here:  
copy board and simplified  
display, below.



An entirely new order of graphic information is now available to intelligence specialists for space-time-form surveillance. The superluous sensing quality of photography, enhanced further by **Houston Fearless Corporation's** electronic Ultrabalance, presents significant strategic and tactical information beyond the scope of present instruments. This new graphic intelligence is retained by a six-phase system of exposure control, contrast intensification by shaped area filtering, innovation of the photographic process, selective amplification, fine driving presentation by electronics, and automated brightness and contrast control during projection. The Ultrabalance is but one of the exciting components of the **Westwood Division's** IAI system of information expansion and interpretation for military and scientific purposes. Inquiries will be given immediate attention. Scientists and engineers wishing to join in this advancement will receive every consideration. **Westwood Division, Houston Fearless Corporation, Los Angeles 46, Calif.**

45

Houston Fearless Corporation, Los Angeles 64, Calif.

AMERICAN JOURNAL OF PHARMACEUTICAL SCIENCE

## **CONSOLIDATED DIESEL ELECTRIC CORPORATION**

CAIRN STREET 8745-AIRPORT, CONNECTICUT - MARIN COUNTY, CALIFORNIA



#### A. First Stage.

The first stage serves several dual tasks: the vehicle is accelerated to orbital velocity and the guidance system is in the dual stage. This control is accomplished by means of an inertial guidance system and by hydrazine ejection which becomes effective toward the end of first stage operation. A variable displacement hydraulic pump in the first stage supplies the control servo for the inertial and solid-state gyroscopes. The pump is mounted in a common shroud. A first stage hydrazine supply provides power for this hydraulic pump assembly. A transponder in the first stage transmits first stage separation, second stage and third stage information. Honeywell provides the descent stage hydrazine, third stage attitude control, hydraulic pump assembly, hydrazine supply and third stage programming.

#### B. Second Stage.

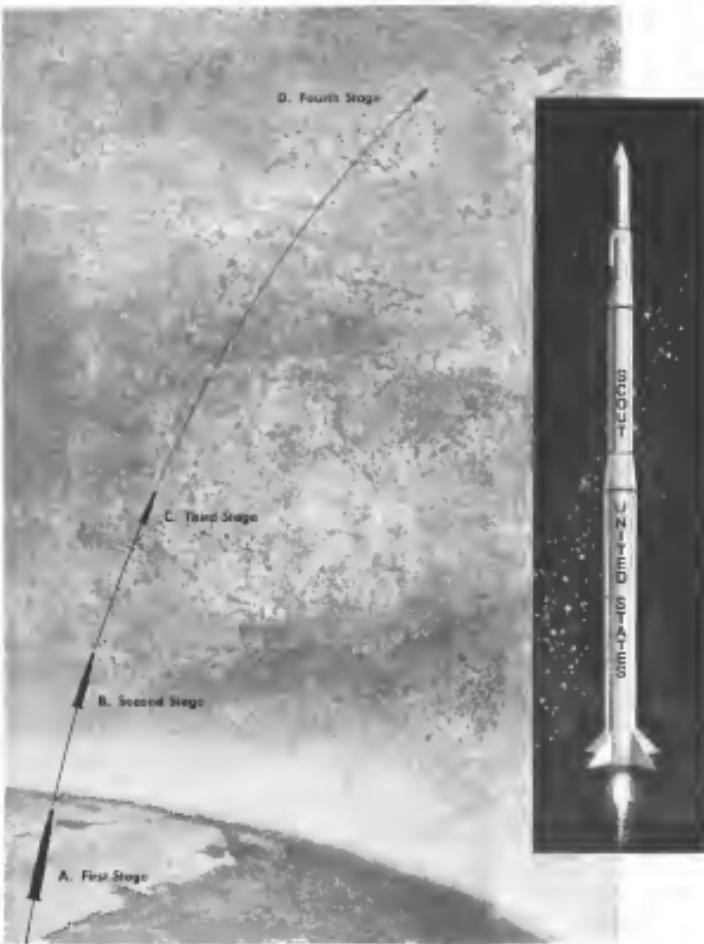
The Honeywell reference system and programmer in the dual stage send command signals to the second stage to control an attitude, separation and second stage and third stage descent. Honeywell provides attitude control as accomplished by means of an attitude hydrazine pump assembly per system.

#### C. Third Stage.

Third stage attitude control is accomplished by means of a two-level 10-micron hydrazine monofluoride system on SCOUT. The Honeywell third stage needs no attitude reference system and programmer; it only requires signals to switch nozzle for the second stage attitude control. This reference system and programmer also control third stage separation and fourth stage separation. The third stage also contains a number of Honeywell hydrazine components plus hydrazine supply and sensors. The overall reference system and programmer can be shown to provide attitude, varying attitude and separation of the third stage, and separation of the fourth stage for control of the high altitude probe mission.

#### D. Fourth Stage.

In the basic SCOUT configuration the fourth stage is a second stage rocket or 150-psi pressurized separation from the third stage and separation. For other missions the fourth stage will separate from the vehicle by means of a Honeywell second reference package housed in the fourth stage.



# The ABC's of SCOUT

**Honeywell provides complete control system integration for unique new NASA "workhorse" space vehicle**

The new NASA Scout, just now making its first penetrations into space, gives the U. S. a multi-purpose vehicle featuring simplicity, reliability and economy. The Scout has been fired twice since July 3, and according to NASA, "guidance and control systems performed satisfactorily on both flights."

To discuss the feasibility and, therefore, the control problems involved in this Scout program, consider that the solid fuel propelled vehicle is designed for a variety of space missions, putting payloads into these orbits: 88 lbs. at 600 mile orbit, 120 lbs. at 300 mile orbit, and 150 lbs. at 180 mile orbit.

Honeywell engineers realized these problems and created a new lightweight, stable control system that provides the flexibility required for this wide range of missions.

The system uses three orthogonally mounted precision attitude integrating gyro providing control of pitch, roll and heading. The gyro receive precise torque commands from the mission programmer to change the vehicle course as commanded with the desired mission path.

With this method of attitude control, your mission flexibility is obtained through simple changes in reference and timing networks.

Honeywell's system analysis of the vehicle requirements also dictated the selection of hydrazine attitude jet valve and servovalve controls for the first stage. Hydrazine propellant selection and system were selected by Honeywell systems specialists for second and third stage control.

Honeywell backs Scout's guidance and control system with complete ground support equipment for servicing, checkout and launch.

The Scout guidance system program is only one of many in which Honeywell has proven its "space mission" space analysis, and design abilities. Other programs include Thor Delta, Discoverer, and Pogo. Military. To learn how Honeywell can help solve your system design and integration problems, contact your nearest Honeywell representative, or write Honeywell, Military Products Group, Minneapolis 8, Minnesota.

#### Engineers and Scientists

Explore the professional opportunities at Honeywell.

## Honeywell

**H** Military Products Group



Performance is the test of Space Technology Leadership

The experience and creativity of Space Technology Laboratories in the field of space systems – both military and civilian – are documented in this record of accomplishments. Remarkably since 1954 for the overall systems engineering and technical direction for the Atlas, Thor, Titan, and Machutes families of the U.S. Air Force ballistic missile programs, and its such advanced space projects as Sove, T-1, T-2, T-3, T-4, and Mercury. Conduct of whole life entry projects and the Project L, Explorer VI, and Project V advanced space probes on behalf of the Air Force. Conduct of Research Projects Agings, and National Aeronautics and Space Administration. Contributions to these projects included design, fabrication, and characterization of specimens, over systems engineering and technical direction, direction of launch and tracking, and data reduction and analysis. This performance demonstrates the STL's continual inability to anticipate and initiate responses in the space challenges. To discharge its growing responsibility in Space Technology Leadership, STL is now broadening the scope of its activities. Research and inquiries concerning opportunities with STL are invited from outstanding scientists and engineers, and will receive immediate attention.

SPACE TECHNOLOGY LABORATORIES, INC. 2000-2001 ANNUAL REPORT

<sup>2</sup> A full discussion of this issue can be found in the following section.

Philosophical Review, 1980, 89, 203-226. © 1980 by Cornell University. All rights reserved. 0031-8108/80/020203-24\$01.00



## EDITORIAL

### Changing Complexion of Space

Space technology in this country is based on the kind of major technical and political changes that will radically alter our complexion during the next few years. These changes will have enormous impact for the American people as a nation and specifically for the aerospace industry, on which the burden of maintaining our technological

This industry faces the prospect of another period of searching with its perennial problems of revolution, technical change, combined with expanding requirements. An expanding aerospace market for exploration, research and for amateur and commercial operational space systems is not visible on the near horizon. The market is at a magnitude that would have been labelled "short history" if it had been seriously predicted even a few years ago.

These technical and political changes are emerging in an atmosphere that is still heavily conditioned by the continuing success (despite apparently canceled funds) of the Soviet space program. The recent Soviet trial of orbiting capsules containing life support systems offers clear warning that Project Mercury is still waging a long-term chase in the race to put the first human beings into orbit and squeeze them above the first reflections by man's eventual development of space as a useful environment.

The Soviet Sputnik VI (Fig. 38) is probably one of the last scientific punctuation marks in the Russian program aimed at putting a two-man orbital, aerospace space capsule into operation. This effort would be viewed in perspective to the current problems of Project Mercury in checking out complete vacuum operations, and it certainly presents a radically different and perhaps even radically simpler approach to the goal of man in space than the Mercury program. If subsequent events prove that these bold and the evidence should be afforded the end of next year—it will indeed be a better pdf for the country, and particularly for the National Aerospace and Space Administration scientists and political and civilian who originally conceived the Mercury program and delivered it to the U.S. aerospace program.

### The Announcing Assault

But NASA will not have to wait for the success or failure of Mercury to turn to Soviet competition to get the first shock of an external public assault on its present position as the primary custodian of the U.S. space program. The character and scope of this assault have been outlined in these pages during recent weeks (AW Nos. 7, p. 21; Nos. 14-16, Nos. 28, 29 and on p. 26 of the current issue) in name and more of the technical foundations for an extremely imaginative and broad scope Air Force space program with though its initial modest, powers.

The USAF proposal offers a far broader utilization of space to radically improve our national defense posture than anything that has been advocated in space reh-

select by NASA or any other organization concerned with this area. Whether this program is taken fully forward and definitely valid raises questions that will certainly have to be answered in the major debate on this subject that is certain to submerge, both in public and behind the security screen, when Congress returns to Washington next month and a new president is inaugurated.

But from the basic state of their improvements is virtually every nook of the space technology spectrum that is now appearing in early experimental form, it is evident that technicians we are still in the early stone age of this historic era. The technical improvements now in prospect offer an enormous opportunity to move forward faster and on a broader front than even the most optimistic source could have imagined a few years ago.

#### A New Look Needed

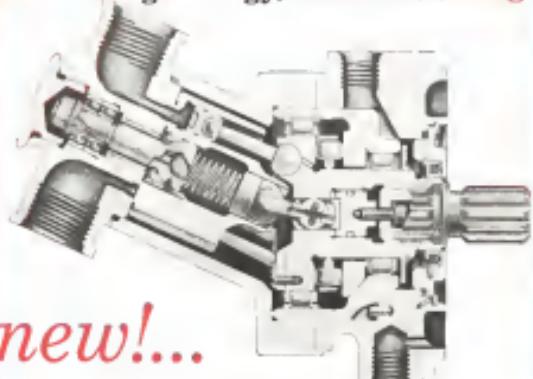
In addition to the major contribution of property using space technology, to strengthen our national defense, gives these new technical developments a prospect and a major role in the development of the space program. Moreover, the development of space has been accompanied by the development and technological progress of space exploration of goals and the preparation of a sense of vital national purpose in this program, which is still leading above the technical working level of government and industry.

In making this appraisal, there should be no timidity about rating and discarding some of the poor management techniques and organizational dynamics that were haphazardly created in the juncture early and sporadic days. This appraisal also should be executed against the current attack of budgetitis that have haphazardly crippled the space program in a formative time. The budgetary problems of an adequate space program are genuinely formidable, but they should be approached with the viewpoint that this is high risk, capital heavy risked on the major scientific horizon advances in technology that can give substantial dividends, scientific, economically and politically in the future of this nation. There must also be an adequate perception against the overtones of technical conservatism that are no longer justified in view of the exponential orbital controls of the past year and the ring glows already, moreover, in the frequency spectrum.

Also major expansion of the national space program, which is approaching its成熟 stage, at the time of the year, cannot be allowed to degenerate into the path, leading of another interplanetary or inter-dimensional realm for the consumption of a budget pool. It must be emphasized with the firm resolve that this is one of the most significant efforts in our national history, and with the understanding that it really will determine a huge number of histories in a nation in the history that unfolds during the last half of this century.

—Robert Holtz

exclusive high energy, low friction design



new!...

## hydraulic motors and pumps

with basically new design features  
offering basically better performance!



More important news for hydraulic design engineers: The Cornelius Company is pleased to announce development of a new line of hydraulic motors and pumps that are lighter, more efficient and more compact. The exclusive, new high energy, low friction design of this equipment is possible because of Cornelius advances. More than 100 design patents covering these products have been issued to date.

If you have specific problems in hydraulic motors and pumps or are not entirely satisfied with the performance you see now, give us your present requirements and we'll be pleased to investigate these new Cornelius products. These new Cornelius pumps and motors can be tailored to meet your specific requirements.

Power in Pressure Systems for Flight

**THE Cornelius** COMPANY  
AERO DIVISION  
224-226 Avenue M E., Minneapolis 22, Minnesota

Qualified individuals will find excellent opportunities available in Cornelius engineering and sales departments.

## WHO'S WHERE

### In the Front Office

Dr Gordon S. Brown, Dean of Manufacturing Institute of Technology, a director of Boeing Manufacturing, Inc., Chicago, Ill.

Donald W. Douglas, Jr., board chairman, aerospace, Inc., Long Beach, Calif., on Nov. 7. p. 10. Other directors are V. C. Lee, Dr. George Van Edwards, W. Stroh, John D. Dugan, Charles R. Atkin and Frank P. Murphy.

Ernest L. Wood, president, Sprague Electric Co., North Adams, Mass., succeeded by late John K. Sprague. The company that originated the Sprague name was founded by William K. Sprague, after whom the company is named, and by Walter A. Langford, his son. Sprague's other relatives are present are president David B. Peck, general manager, Charles R. Wiegfeld, Curtis G. Ellsworth and sales vice pres. Bruce E. Carlson, corporate planning and finance.

George H. Hart, president, International Research and Development Corp., Woodbury, Conn.

Old Fidelity was president, operations planning, Curtis Wright Corp., Woodbury, Conn.

Keith T. McMillan, chairman and president, the Police Bureau Co., N.Y. Branch, Vice Pres. John S. Coffey, managing director, Edwin A. Ingberman, assistant treasurer.

George LeClerc, vice president, sales, Los Angeles Division, General Precision Inc., Los Angeles, Calif.

Cougar, Ltd., Montreal, Canada, has announced the following appointments: Frederick R. Keane, executive vice president and finance; John Wren, vice president, engineering; and James G. McGehee, Theodore G. Radford, treasurer.

Dr Charles F. Robinson, a vice president of Consolidated Laboratories Corp., a subsidiary of Bell & Howell, Pasadena, Calif., has been reelected as director of the Bell & Howell Research Foundation.

William E. Vickerman and Curtis M. Kelly, vice presidents, Litton Industries' newly created 10th Group, Calif., Mr. Vickerman oversees research and controller, and Mr. Kelly is charge of marketing, public relations and public affairs.

Carl E. Hirschman, commercial sales products market development, Rathbone Co., Woburn, Mass.

Mr. George Robert Jr., Booth USA, Chair of B-1 Defense Systems Support Agency, Washington, D.C., succeeded Vice Adm. Edward N. Parker, USN.

### Honors and Elections

Dr. R. R. Johnson, assistant chief engineer and head of the Range Department of Battelle Seattle Research Center, has been appointed the 50th chairman of the American Louis DeLoach Award. In recognition of the work of the flight test flight research design team and of the company's achievement in the field of aerospace programs. (Continued on page 119)

## INDUSTRY OBSERVER

► Air Force will use Lockheed C-130s for an edition of the Soviet reconnaissance satellite, known as the "big bird." Lockheed C-130s, to handle. The same ships are scheduled before the first series attempt is planned for next September. The 899th Test Squadron expects to get in first C-130 about Oct. 1, and conversion from C-130s used for previous recoveries to a fleet of five C-130s is to be completed next spring.

► NASA's Echo II passive communications satellite, probably will be 140 ft in diameter, an increase over the size of the 100-ft Echo I sphere. Echo II's aluminum sphere is expected to use microwave communications for voice, television and data.

► Convair's F-105 interceptors will be used as a chase plane for the Mercury-Redstone flights. F-105s will escort the launch and return flights. National Aeronautics and Space Administration originally considered the Lockheed F-104 for the chase role. (AW, Nov. 21, p. 27)

► Ultraviolet terminal guidance system, with all-weather capability, for ballistic missiles has been proposed in the Air Force by Avco Research and Advanced Development Division. Ultraviolet systems, operating at the opposite end of the light spectrum from infrared systems, have a number of possible applications, including aircraft navigation displays.

► Programs are due today for a spectrum surveillance system capable of monitoring all frequencies, isolated at Air Force Missile Test Center's launch site at Cape Canaveral. The system is to analyze frequencies for their nature and origin, in an effort to monitor and measure sources of electro-magnetic interference with operation of missile systems, gear during check out and launch.

► Australian technological evaluation favors the Dassault Mirage III for the RAAF fighter role if modifications are made to give the French fighter a 1,900-mi range. With the technical evaluation complete, final decision between the Mirage III and the Lockheed F-104, including financial considerations, now can be made.

► Recent Navy bidding on purpose and fabric of the Transit satellite in orbit held by Battelle of Seattle, Westinghouse and Johns Hopkins Applied Physics Laboratory, Oct. 17, p. 23, was attended by about 80 companies. It was not a formal bidding bidding but requests for proposals for shipboard digital equipment to receive navigation data from Transit system probably will be issued within 60 days, possibly without a formal bidding. Navy indicated it does not want to sponsor separate company development for the bus.

► Four aircraft-to-aircraft compatibility flight test of the Air Force-Douglas Skyhawk air-to-airlock ballistic missile, originally scheduled for the month, now has slipped to mid-January. A B-52 will carry four Skyhawk missiles in test flights from Boeing's Wichita plant.

► Philippines air force is considering the Lockheed L-104 and Convair C-102 as replacements for its North American T-28s. L-104 is favored because of its all-weather intercept capability. (Continued on page 118)

► British Blue Steel anti-submarine missiles are being shipped to Australia for test flights over the Southern using Royal Air Force Vickers Varsity. Missiles are supplied by Royal Australian Air Force to C-118s.

► Switch to a tetra-fluoromethane could cut the present 18-ft length of the 1.5-million-lb thrust Rocketdyne F-1 engine to about 7 ft. Vickers length has reported shorter in the airframe gas problems with such long engines as Saturn and the proposed Nova, which would be powered by the F-1. Layouts featuring shorter engines are the major concern. Short configuration of the engine, however, in its present size, appears, although otherwise is slightly below that of the longer bell-shaped nozzle.

## IMAGINATION ON THE PROWL



System leadership combines **imagination**, practical know-how, and firm management. That aggressive combination is the Bendix Systems Division. Career opportunities include the Eagle missile system, Advent satellite communications, space projects, and airborne infrared systems.

**BENDIX SYSTEMS DIVISION**  
ANN ARBOR, MICHIGAN



## Washington Roundup

### Military Space Ferment

An expanded military space program is almost certain to result from the combination of legislative and executive department changes expected during the first days of the Kennedy Administration—but not until after the dust has settled around some bitter skirmishes on Capitol Hill.

Reorganization of the Defense Department, which includes the outside possibility that all military research and development will be put under one agency, may have to be delayed at first.

As *Time* has the most ambitious plan for growth (see p. 26), and has had its groundbreaking crusade, it has support for at least some of its ideas from Vice President Lyndon Johnson, who will be a powerful factor in the Administration's space decisions.

Both the Senate and House space committees have shown sympathy in the past for the Senatorial dilemma—trading the responsibilities for space defense without being dependent on the National Aeronautics and Space Administration for much of the support of a catalog.

The House committee has asked each service for detailed compilation of all current and projected space programs. They are due this week.

Budgets of the military services for Fiscal 1962 will total only about 2.5-3% above the current one by the time Senator of Defense Thomas Connally returns from the Budget Bureau next week. Orders for most of the cutting and reshuffling appear to originate with Dr. Robert York, director of defense research and engineering. In an unexpected turnabout, York got stiff opposition on a number of cuts from John H. Baker, the man who filled his post while York was ill recently.

### Space Council Revival

After almost a year of inactivity, the National Aeronautics and Space Council may be reactivated. It was created in the original space act of 1958 at the insistence of Lyndon Johnson specifically to plan responsibility for the space program immediately at the presidential level.

President Johnson cited last January that the Council should be abolished. Presidential staff has never commented, and even then the Council held meetings for two or three months in 1961, according to *Space News*.

Johnson wants close contact with department heads like Eisenhower had. The Council, which brings together the Secretaries of State and Defense, the heads of NASA and the Atomic Energy Commission and others, is an ideal vehicle. Johnson himself probably would sit in on meetings.

A Dec. 15 deadline for presentation of industry's view on reorganization has been set by the House, Ways and Means Committee. Response is varying from the opinion that an reorganization is futile to plans for vigorous opposition to the Reorganization Act in the present form. Aerospace industry, Aeronautics, Avco, planes to appoint a task force to negotiate an industry-wide position.

Reorganization might be AIA last year were rejected, and Congress extended the act until June 30, 1962. The extension last imposed Ways and Means is making a third and without economy conditions to next Mar. 31.

### Senate Studies CAB

Senate Commerce Committee's staff study on the Civil Aeronautics Board and other regulation agencies made its first, first August, public emphasis on reduction of the currently enormous backlog of cases.

General Counsel's Office is making thorough pilot study of Interstate Commerce Commission, at the request of Chairman Walter M. Mondale (D-Wash.) with the intent that findings will be applicable to other quasi-judicial agencies.

GAO's report is expected early in January, and committee hearings are expected to be held early in the next Congress.

Air Force is making a concerted effort to show that its Minuteman missile system is 25% cheaper than the Atlas Polaris. Navy claims its cost figures exclude everything down to hot temperatures for the crew to end from the submarine. It says the Air Force makes its own accounting rules ignoring this cost.

Lt. Gen. Robert J. Wood has labeled the Nike Zeus anti-ballistic missile a "terrible weapon." Wood, head of the Army Air Defense Command, says this weapon is his lifeblood on the ground even though it kills targets that are way out.

Westinghouse will develop a high energy arc heater for NASA under an unusual \$100,000 contract that will cost NASA nothing unless the heating reaches up to an existing model—nearly guaranteed performance.

—Washington Staff

# Air Force Outlines Broad Space Plans

USAF prepares to fight for space policy changes to pave the way for a variety of weapon systems.

By Larry Hodes

Washington—Air Force is preparing a major political offensive to bring about changes in national space policy and law that would let it proceed with detailed, specific plans for space weapon systems involving "hundreds of thousands" of satellites in orbit in the next 15 years.

To the latest of a continuing series of technical briefings to industry leaders and groups within the service, Air Research and Development Command's Ballistic Missile Division has claimed that Air Force has offensive, defensive and logistic actions to perform in space. "Military space," defined as space out to 10 earth diameters, is the battleground of the future, USAF says.

Air Force has as its position on the results of a number of funded and un-funded studies, compiled by itself and subunits over the past three years, a briefing Defense Department policymakers and its legislative defense of its arguments for the next seven of Congress.

Conclusions in key committee posts and their staffs already have received informal briefings. This has been told that Air Force's plans for future military utilization of space are far more imaginative and complete than those of the Office of the Secretary of Defense and the National Aerospace Council.

Air Force is being given a chance to a broader space role on the language of the National Aerospace and Space Act of 1958. This act charges the civilian space agency with making "adequate provision" for armaments and space activities.

But it is this "adequate provision" that constitutes positive or primary mission with the development of weapon systems, military operations or the defense of the U.S. (including the research and development necessary to make effective provision for the defense of the U.S. shall be the responsibility of, and shall be directed by, the Department of Defense).

The concept advanced by Air Force is that it must hold its portion of the space defense mission without clear recognition at the top official levels of its need to pursue a broader research and development program on space systems.

Until now, policy based on the space act has given NASA the responsibility for around space flight and development of long duration. Air Force wants to use this policy changed to allow it to perform both tasks as necessary to carry out its own mission, regardless of what the civilian agency does.

Polite missile. Ballistic division is well on its way to doing this by 1964 (see p. 25).

Systems already in development or planned by USAF for an expanded space program include:

- **Offensive—** Tactical Control Bombardment System (TCBS), sometimes called Reusable Intercontinental Ballistic Missile and trade-named ICBM, sometimes called Midget Man + Detection-Spud, Random Range and Icarus.

- **Logistics—** Satellite Maintenance and Repair Technique (Smart) and Military Space Launching System (Molot). Space Plane (Aug. Oct. 31, p. 28), was not included in the briefing.

- **Reconnaissance—** Satellite photographic satellite. Moltin renamed ICBM, including detection, surveillance, and Space Intelligence orbital intercept (see p. 27).

- **Communication—** Communications Satellite, Advanced Research (Casa), which until recently was called Fixed Link Aerospace to Ground (Flag).

In general, area analysts have emphasized that the U.S. spent more on non-ICBMs than Russia and most nations strive for ingenuity in this extension of strategic war.

It is desirable to reduce launching costs, leaders said, so that system involving tens of thousands of satellites will not be prohibitively expensive. Launch costs, which are now on the order of thousands of dollars per pound of payload, must be brought down to \$100 or even \$10 per pound. Launching should be a concern in R&D, R-34, although it is not a priority in cost.

Additional objectives are to increase satellite life by improved component reliability and better space power supplies.

Maneuverability in flight will be a standard requirement for all new ballistic missiles and satellites.

Tactical Control Bombardment System or Reusable ICBM, would involve three or more maneuverable satellites orbiting at 100 miles per minute. Each unit in orbit, re-entering fragments of the satellite would be varied to prevent attacking a target from distances of a mile more than 5,000 miles or to as much as 10,000 miles on. This would be accomplished by varying the reentry angle from orbit.

This would be an 18-month line of sight period. The satellite would be similar when it would make a reentry. On receiving a command, the satellite would switch to intercept for its reentry at the programmed time, separate the on-orbit reentry vehicle from the satellite and the reentry vehicle would proceed to the

## RCA Will Develop Saint Payload

Washington—RCA Corporation of America has been chosen to develop the first stage and uppermost payload for the Saint satellite relay and navigation system.

Payload will weigh nearly two tons and will carry a housing rate and television camera for intercepting television satellites for teleconference purposes (AVN Oct. 31, p. 26). Saint will be launched from Cape Canaveral in an Atlas booster, and it will be ignited into orbit by an Agave II second stage.

Initial contact with the television satellite will be from short and short by less than 50 miles. Relays will allow Saint to produce an initial closing rate of 1,500 mph which will be reduced to less than 10 mph at the Saint satellite occurs within about 50 H. of the target.

Demands on the payload are scheduled to begin in December 1961. This includes which will evaluate the role of one or more three month and September of 1962 to be selected against selection of 25 ft. high previously launched into 400-mile orbit.

RCA contract is of total \$25 million of about \$10 million budgeted for the first system development effort. Work is planned for detailed lessons for Middle and Far East Control Station at Burlington, Vt., the Airborne Satellite Division at Clarendon, N.J. and the Auto-Electronics Division at Princeton, N.J. The project will mark the first RCA development of a complete mobile or mobile system.

Eight satellites will be built four intended for orbital tests. Of the remaining four, one will be for type testing in environmental chamber and will be a spare of Cape Canaveral one will be used for full power ground socket test and one will be an engineering model for a realistic reading.

First four test vehicles will weigh about 2,200 lb. Operational vehicles may be double that weight.

Reliability demonstration will be attempted under a set of conditions offering the greatest chance of success. Engels will be orbiting in the same plane as the Saint vehicle while both will be launched from Cape Canaveral.

Any later operational system would have to have drag capability to alter the orbital plane. The reentry vehicle sufficiently to make an interception with another vehicle within range.

Will be provided to the Ballistic Missile Division of the Air Research and Development Command, while telephone representatives will be made Aerospace Corp. Military support will include the National Space and Surveillance Control Center at Vandenberg, Calif., which will coordinate the tracking the 8194th Strategic Air Wing at Vandenberg, Calif., and the 8194th Missile Test Wing at Patrick AFB, Fla.

target and deorbit its warhead.

The possible feature is the provision that, if at any time during the man made survival the final attack signal is not received, the vehicle will automatically deorbit its payload for reentry to the original target. It will then re-enter over a predicated reentry zone area, search for warhead reentry, and descend into water.

### Maneuverable Trucks

With development of atomic nuclear weapons, Manned Reentry Capsules (MRCs) used in orbital flights, Air Force plans to add further mobility to payload vehicles by separating them on needs. A 30-ton truck, would carry a 12-ton truck. Guidance would be by manual package or radio command.

Navy Polaris and Army Pershing II have been offered for MRCs. The Pershing would be done by utilizing space plane.

Studies have indicated that regular maintenance is mandatory because no components can be disassembled with infinite life. Failure rates have been studied during various government flight and test programs and indicate that the failure rate is high. The Pershing would be launched package or radio command.

In the realm of logistics, the Saint concept, for Satellite Maintenance and

Expanding its interest into the field of big business, Air Force has selected the field of long duration, or Military Space. Long duration, Saint would have 300-500 lb. thrust and would be capable of putting several satellites into orbit.

Program is a set of overall approach to selection of space launch craft through monitoring and raising load on and launching from installations of space. System development is planned to begin in 1961, with the first launch planned for 1967.

### Mother Ship

Space Plane would be a type of mother ship. That 300,000 lb. vehicle would take up several months with an initial set of high priority tasks and then the first major function of the space plane. While flying there, it would gather data through various systems, cameras and liquid and gas fuel tanks. Once it got liquid oxygen. After this cycle the vehicle would weigh one million pounds and could proceed on its logistic and explosive mission.

A variation of this concept has the vehicle operating as a space converted past to direct military operations in orbital space or systems now in deep space.

In the area of defense against ICBMs, called MCMC, the Air Force has also in its repertoire three missiles shortly after their initial flight a launching pad or site. This would be done by solid fuel.

There are several ways to accomplish the maneuver and fall. One is to have a center satellite which would release smaller satellites to make the fall. Another is the fly it yourself type which would make the maneuver and fall in its own initiative.

In any case the missile must be able to maneuver separately after it may have a closed loop. In such a manner the time, distance is compressed to the extent that only a few months are available for detection, interception and fall. Interception should be made before the onset of the booster.

### Rendevous Orbits

One approach is that made by Convair's orbital spaceplane (AVN Oct. 31, p. 31). This concept calls for 2,000 to 5,000 payloads in random orbits of about 200 miles as altitude. Each satellite would carry from one to ten blocks which would be launched for interception and fall. Detection capability would be built into the vehicle.

Another study, conducted by Thompson Ramo Wooldridge and called X-15, would ensure 20,000 to 100,000 units in random orbits. In this system the satellite itself would make the fall. This module is designed as a simple one with no moving parts. Each

one would have a major share of two years before factors.

Lordhord's strategic nuclear model is a follow-on to his Soviet inspection model, which is designed to determine the nature of nuclear weapons. Strategic weapons would include measures ability to make sure that one can't another except until the first, if the destruction capability.

If one of the MRCM nations are opposed development will begin in 1962 and an initial operational right before 1967 and deployment by 1971.

In considering any future combat capability, ABDC planners say that a military communications satellite system is required. One-based flag would require Soviet Union's Admire one system to one satellite.

One is described as a minimum 24-hr communications satellite, suitable for long range strategic communications. It should be developed in time to be ready to operate, along with the operational systems described first. One, one satellite would be situated so the coverage spans the months of

the Amazon Basin and southern non-Christians Island in the Pacific.

First would be four orbit cells. Each would weigh about two tons. For strategic operation it would be capable of operating several depots simultaneously, thus allowing all known planning flexibility. In practice, loads of space depots, through 10 tons as more, will be available, and one loadable channel for information or data would be handled. Operation would be by three transmitters and three receivers covering a band from 4,000-8,000 mc

satellite. Information collected by the 60-ft dish antenna on San Nicolas is relayed directly to an on-board data transmission system to the meteorological research center at Pacific Missile Range headquarters, Pt. Mags. Infrared readings of the earth's clouds by Tiros are transferred from Pt. Mags to California Space Flight Center, which drives Tiros II operation.

Cloud photographs released from the satellite, recorded on video tape at San Nicolas and transmitted to Pt. Mags are analyzed there and plotted on three charts, called "superclouds," for future reference. Information from the U.S. Weather Bureau meteorological satellite service and to Navy and USAF weather services via the National Meteorological Center at Suitland, Md., and to the U.S. Space Fleet at West Weather Facility, Honolulu, Calif.

Analysts and forecasters are using a manual prepared by the Weather Bureau showing cloud patterns taken from Tiros I compared with cloud patterns taken from the ground. The superclouds will be used in preparing forecasts over a large part of the northern hemisphere.

Plane communications techniques are being used to extract as much useful data possible from the patterns, then the superclouds are broken down into photographs which permit fast identification when used with data from the stereoscopic cameras. Photos from the stereoscopic cameras are recorded about 85% useful.

Two days after launch, but of first use of spin stabilizers were fired on ground command to increase stabilization spin rate and eliminate a wobble. Miltire Research Corp. measured spin from 8 to 10.8 rpm on the first firing, and to 11.9 rpm on the second.

Despite a malfunction in its cover, the Tiros II satellite provided the best low-Months for cloud images which showed movement of a storm which brought the winter's first snows to the Midwest. Charts also showed heavy sea in the North Atlantic and wave-height movement of a large low pressure area

## Decision Near on NATO Nuclear Weapons

By Carl Brodsky

Final decision in simplest terms is to adopt a plan like East Germany's proposal to make the North Atlantic Treaty Organization the world's fourth nuclear power. The proposal will be declared at the annual defense minister meeting here in March. The outcome is doubtful.

A formal ministerial meeting beginning Dec. 16 is expected to handle the matter in its own political subcommittee but authorized final judgment in order not to give the appearance that the matter was decided purely on political grounds, like the wisdom of a

December announcement by Vice President Lyndon Johnson at the recent annual NATO parliamentary conference here—where West Germany's nuclear-armed corps and Johnson's subsequent assurance that U.S. leadership for the organization will continue full force under the new Administration, endorsement of the plan by Kennedy after he became office in late April, and before final approval it was submitted.

### West Germans Support

The strongest factor and the nation with the most to gain is West Germany, where plans for a 1,000-bomber nuclear strike force in the mid-1960s will make it the strongest force in the European continent. This force hardly can be effective if it's held back under nuclear weapons, an increasingly available source of the present condominium concept of European defense from central depots and administration of atomic weapons for conventional systems now in place that can't be taken into the air. The plan plays a prominent role in the defense of the west of western Europe.

Opposing that is the West German government, which is split on the issue of nuclear weapons and would like to see the introduction of nuclear weapons in Europe.

In the other West German political group to gain from Germany is a broad-based force which sees there as one of nuclear weapons would create the internal problems of conceivable debates as to just how German weapons would possibly be used. Miltire Research Corp. measured spin from 8 to 10.8 rpm on the first firing, and to 11.9 rpm on the second.

Despite a malfunction in its cover,

the proposal would, of course, require congressional approval before a change in the existing law that disarms the fourth nuclear weapons system under the control of U.S. forces before an full implementation of rules expected in West Germany's proposal.

### Pressures For Approval

Parliament has still not approved the proposal, which is the next European parliamentary session, but the control of weapons might be passed to the AFSCM so that they might be transferred to NATO by the end of the Atlantic's in its present form. When a speech was made, I am speaking of the present form, in the middle of the year which defines the weapons but I am speaking of the specific components which are now returned to the strategic council [in the United States]. It cannot be assumed that the revision of a multilateral atomic authority, making NATO a fourth atomic power, as has been proposed would necessarily influence the desire of some states [notably Israel] to pursue their own independent nuclear forces in more weapons capable. However such actions might not well satisfy the desire and in terms of efforts to increase the AFSCM's authority, requirements and so on, an agreed-upon force of the control of the strategic pool of forces which could be established is expected in the first days of December.

West Berlin concluded his proposal with the statement that "a political, terrible, arms race is not in the Atlantic greater control over atomic weapons and no subject that we can cause efforts to the effective will could be a great and dramatic step."

### Proposal Made Previously

West Berlin's plan outlined last December in a speech at the Institute of World Meteorology, at the University of Southern California in Pasadena, or what can have been a mid-October in the public and political meeting in the United States.

Two paragraphs preceding his death nuclear power suggestion at the NATO parliamentary conference included the severest for rearmament with the introduction of medium-range ballistic missiles, which that gave rise to discussions of the Palau, for instance, and "long strategic missiles, known." As to the latter, West Berlin said "That is an extremely interesting thought but one which he has to us knowledge, been proposed by or within the Atlantic. It has not been suggested by me, or my headquarters."

## Tiros II Has Wide-Angle Camera Trouble

Washington—Data from the satellite is proving excellent, although data, but uncertainty about performance of the wide-angle cameras will require enough ground to correct 510,000 pixels.

Although initial operation of the instrument showed high promise (AVN, Nov. 28, p. 42), the wide-angle cameras especially were panned out of focus at launch, though they probably will bring that to a design eight.

The early difference in the cameras not believed to have resulted from a high power drain at launch, and the situation was expected to be corrected by recentering of the optics. After a week of operation, with 100,000 closed circuit pictures transmitted daily, the

problem is believed to be in orbital focus.

Although there is an experimental attitude, the position and health caused by an experimental attitude will have to be investigated. In testing data from this instrument, meteorological measurements obtained from the satellite, it is now taking between two and three hours to reduce Tiros data and make it available to users. That time should become shorter as experience increases.

Normal operation of the 800-kilometer-diameter stereoscopic cameras of the Pacific Missile Range and the 150-kilometer-diameter Signal Radar can data retransmitted from the



TIROS II's stereoscopic cameras transmitted this series of cloud formations while the orbiting satellite was northeast of Los Angeles, looking west at the California coastline, which is obscured by the clouds. Photo, taken on 9/26/60, was received by the Los Angeles tracking station at Pt. Mags, Calif. Photo was transmitted at 11:25 AM PST on Nov. 28.



REDSTONE-MERCURY sequence shows ignition and then immediate climbout.

On shutdown signal, which came with inflation of

boosters, tower damping ring was released by explosive bolts and escape rocket fired, carrying the escape chute, lands with it.

## Second MR-1 Test Planned in Two Weeks

By Edward H. Koloski

Washington — Mercury-Redstone 1 (MR-1) launch attempt will be repeated in about two weeks with revised ground equipment altered to circumvent the abnormal power disconnect feature which shot down the booster engine which after ignition in the initial MR-1 flight.

Recent MR-1 test (AVW Nov. 28, p. 28) was the third successive launch failure in the Mercury program. Previously, the McDonnell MR-1 had a hard, no-flight failed.

Although General Atomics and Space Administration has yet to fly a rocket booster production capsule, Mercury program managers were heartened by the findings of investigators of the capsule during the abortive Redstone test. The prolonged capsule following track signal determined it will be fitted with new stage timer and proximity sensors which are activated during the Redstone test, and it will fly as MR-1 in the same sequence planned for the launch that failed.

Mercury Director Robert R. Gilruth estimates that the Nov. 21 failure will delay the program a matter of weeks and it will have no significant effect on program cost since both the capsule and booster created essentially the same flow. Gilruth said that a second Redstone-Redstone flight will be made only

next year and the second, Maniacal orbital mission will be launched before the end of 1961.

The MR-1 booster will be new because the Redstone used in the initial attempt failed 0.25 to 0.3 sec. before dropping back to the pad, and it was dropped back to Marshall Space Flight Center for a structural check.

### Early Discrepancy

Dr. Johnnie P. Koethen, Mercury project chief at Marshall, traced the launch malfunction to early disconnection of the power plug from one electrical ground connection and a faulty ground and control plug arrangement in the disconnect mechanism. A small metal bolt lost with a force differential of 20 kilograms. Power plug is used to ground the capsule and negative side of the battery, and with the booster not grounded, the control circuit got just 1 voltage reading when closed the capsule door and shot down the escape power plug that was found to be 1 ohm short in the control plug and this could have resulted in a slight rate discrepancy.

Koethen said the situation is being corrected by lengthening cables in a way that the booster will remain grounded until the control plug is disconnected and by welding both plugs the same way.

Supposed malfunction has not as-

serted or more than 50 batches of test and research vehicles based on the Redstone booster. Koethen said possible explanation for the MR-1 accident is that safety for the MR-1 program is much more stringent, and the capsule switch picked up a voltage which would have been present in standard Redstone switches.

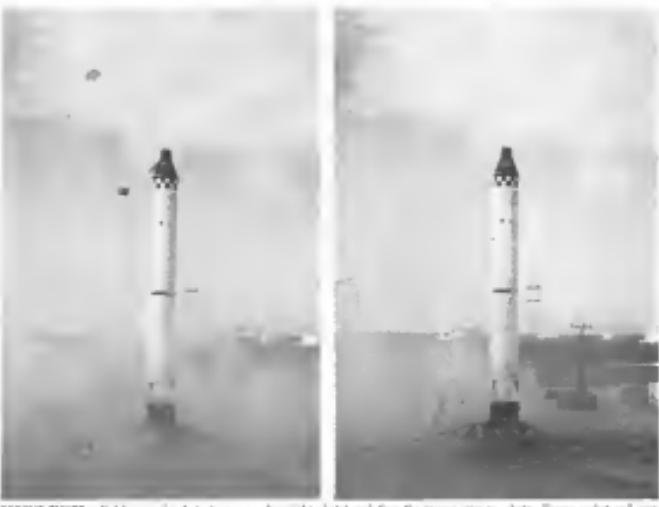
Some of the discrepancy in the Mercury group from the failure was eliminated when its cause was isolated quickly and found easy to fix. Copilot voice preference was not emerging.

### Capsule Sequence

Closest and first sequence will place where the capsule could signal not given. Tower damping ring was separated by explosive bolts.

• Escape rocket fired immediately after tower separation and crossed the 10-ft rocket plume, 1,500 ft. west of the pad, where a launch still in the void. Rocket burned one second and then the tower returned to an altitude of over 10,000 ft.

• Recovery system was armed by putting escape power arrest switch circuit, by a natural process, the circuit is closed at 12,000 ft. altitude. During the capsule was at 10,000 ft. pressure, the hornmeter switch was closed and the drogue parachute was fired by its sensor. The drogue chute was fired



RECOVERY sequence shows capsule being lowered from the recovery aircraft (left photo) and then the capsule having landed on the ground (right photo). The drogue chute will be replaced in this attempt and it will be used again for a second attempt to launch the first Redstone-Mercury flight.

## Chimps Delivered for Mercury

Cape Canaveral—Four chimpanzees have been delivered here in preparation for the first instrumented launch of a Mercury capsule. Recent return of the Mercury Recovery vehicle (AWW Nov. 25, p. 20) however, has only temporarily delayed the first tethered flight of the animals.

One group of four adult—female apes, and one female—juvenile bear two weeks ago, a second group of four is scheduled to be shipped in about four weeks. Each of the four chimpanzees passively bear a bearing kept in a separate cage to prevent a cold or wet disease from spreading in the others. Apes are two to three years old; weight about 65 lb., and approximately 50 in. tall and have been raised at the USAF Ames Research Laboratory, Moffett Field, Calif.

The chimpanzees will undergo further training and testing in the Mercury hangar at the Cape, making two-hour unweighted space flights in pressurized Mercury capsules within a special altitude chamber. This will be run at a simulated altitude of 110,000 ft with internal capsule pressure of 3 psi. Animals will be called upon to perform standard tasks while constrained during the planned flights as they will in orbital maneuver and orbital flights.

Objective of these simulated flights will be the proper functioning of the biological data tape recorder system designed for Mercury. Major household interests will be the EECs, respiratory rates and temperatures of the animals while under test. Capillary permeability will also be evaluated. Each chimpanzee has been specially marked with fluorescent paint and has been radio-tracked without fail.

to the front of its nose, and it pulled the main parachute out. Reserve chute activated by a force sensor, and when the sensor did not pull up the opening load of the main parachute, the reserve chute also exploded. Hydrogen pressure had for attitude pitch was dumped from the tank.

With the hot boosters on the pad, a potentially dangerous situation was compounded by the wind blast of the two solid rocket boosters launching from the top of the capsule. Because high winds were not forecast, it was decided to clear the area used for Redstone's batteries and decontaminate the hydrogen and oxygen evaporated and vented.

### Catell Signs

When the capsule received the signal to perform its orbit it did not receive a cutoff signal, which turns off orbital television, which turns off the capsule's television, and which turns off the capsule's television, because the capsule sequence was being run on board the separation. This is not normal, this was a test.

Associate Manager Director Walter C. Williams said that if there was an attempt to turn the capsule's television on board the separation, the television would have been used to move less.

Possible factors, used on a several occasion to turn the capsule away from the booster after boost, did not fire and the booster capsule adapter ring did not part because a force sensor which closes the match ignition at a 42g force. Possible factors were aimed when the lower boost, but the retrograde ignited to take the capsule out of orbit—was not sensed because this didn't occur until the booster and capsule separate.

Mercury capsule actually began a

suspense which should have been exhausted 14 hr after liftoff when the MR vehicle was to have moved a 36 hr altitude.

## Renegotiation Record Subpoena Case Decided

Washington—Aviation Corp. has been granted post trial discovery and has been granted a new trial by the 9th Circuit Court of Appeals, which upheld the Board of Contract Appeals' decision that the Air Force had violated the contract by failing to pay the company \$1.5 million excessive profits for 1952.

As ordered directed by U. S. District Court Judge Alexander Hollof, will these two key provisions:

• The company is entitled to the "post-termination" profits of the military services. These largely repeat certain observations by military procurement officials as well as facts on Boeing's production performance and were contained in the Board's decision. The company's agreement to its profits determination agrees the company

• Boeing is barred from obtaining increased compensation of the Board on the basis of excessive profits. That would exclude all staff increments resulting from the new and non-negotiations as such.

The Boeing 1952 excessive profits case will be reviewed shortly before the U. S. Court of Appeals in Seattle, and the two sides of the dispute will be heard before the court of appeals in 1958 pending disposition of the case.

In addition to the \$1.5 million excess profit case for 1952, Boeing also is confronting three other Renegotiation

Board determinations in the Tin Court \$7.3 million for 1953, \$9.7 million for 1954, and \$6.3 million for 1955. The total for the four cases is \$33.3 million. The 1955-57 cases will follow the decision on the 1952 case. The Board has denied Boeing of any excessive profits for 1956 and 1957 (AWW Nov. 1, p. 81).

## Labor Dispute Ended At Saturn Launch Site

Washington—Union—paradoxical dispute continues to plague construction projects at KSCM and space launch bases, although the parties were saluted temporarily last week when workers made a strike at the Atlantic Missile Range Saturn launch complex.

Boeing sent 200 men back to work

on the Saturn complex after the Department of Labor agreed to appoint a fact-finding committee to investigate the construction project dispute.

Afis, Fatas and Mooneyham—paradoxical problems were discussed last week at the quarterly meeting of the AFL-CIO Building Trades Council, composed of the presidents of 18 construction unions. Major development has the meaning not an agreement to resolve various jurisdictional problems to see how they can be applied to certain problems, and to get the topic high on the agenda for a Plenum meeting in Miami.

After a year of negotiations, the

Joint Council of Engineers says its negotiations with the AFL-CIO have stalled (AWW Oct. 31, p. 5), but labor problems continue. Last week, the company agreed last week at the Walker AFB, N. M., Adair has a jurisdictional dispute.

Despite the AMR arms when members of the International Brotherhood of Teamsters Workers preferred assignment of Civil Service workers who are familiar with the system, to take electronic equipment in a job being carried without weapons. Electronic workers in the Saturn project walked off Nov. 14, and the Planners and Pipefitters Union left a week later.

National Airlines and Space 46 management requested an injunction Nov. 19 to end the walkout, saying that the National Labor Relations Board did not rule on the request when it appeared that no agreement would be reached.

The Department announced a temporary injunction Nov. 25, but the union concluded their agreement on the use of electronic equipment to investigate the situation. The Labor Department appointed the case referee, composed of representatives of the two unions, Labor Department, NASA and Defense Department, and the group was scheduled to go to Cape Canaveral later this week.



**FIRST UNTETHERED** Hovering flight of the Hawker P.1127 on Nov. 24 was made by test pilot A. W. "Bill" Bedford. Plans are being hatched close enough to ground to obtain favorable effect from ground reflection of the discharge from the four firing jets. Color stills, radio strip and telephone line for measurement indicate that radio equipment was not installed for these first four flights of hover flights. Note also that landing gear down, nose down and other components adding unnecessary weight have been removed.

## Hawker P.1127 Makes First Hovering Test

London—Hawker P. 1127 VTOL fighter prototype made its first untethered hovering flight Nov. 24, just about one year after the initial untethered flight on Oct. 21 and less than 18 months after the first tethered hovering flight made in October.

Powered by Bristol Siddeley P. 136 forward jet engine with about 8000 lb thrust using propellant amounting 11,000 lb, the plane was flown by Hawker pilot A. W. Bedford in a demonstration of a new technique.

First photos of the P. 1127 show the aircraft that had perhaps necessary approach followed by Hawker and Bristol Siddeley in the hovering trials which took both engine and engine shift for the first time. The plane was stripped of even lot of luxuries and in specimen form the nose boom was fit-

ting flight test instrumentation and the landing gear down. Not even a lead or iron was taken from those instruments in the photo.

During the flights, Bedford failed to ground control telephone line suddenly and the control system was rapidly brought back into control.

Special bell mouth lips for the engine air intake were mounted for these tests to get the closest approximation to ideal airfield conditions for the in ground in order to obtain the best possible range of flight from the powerplant.

A second prototype, P. 1127 in racing configuration at the Hawker plant and is expected to join the first for the first flight in a few months. Hawker plans already have been made for Bell X-14 VTOL research in the U. S. to gain experience with deflected jet aircraft.

There is a need to order a quantity of Hawker P. 1127 aircraft, perhaps 25 to 30 in order to form a line squadron for pilot training and initial operating experience with the type. Most ob-



**FIRST PHOTO** of the Hawker P-1127 V/STOL, side fighter profile, shows two of the four inlets leading intake to venturi to sustain the thrust of the plane's single Bristol Siddeley BS-51 forced air turbojet. Present intake discharge pattern of fan flow, at 1000 rpm, at 1000 ft/sec. Inlet flow is modulated with bell mouth lips for heat flow characteristics.

seems agree this is a desirable approach to produce maximum return on the Hawker venture and the investment in the program.

The Hawker design as it stands now could not meet an updated report limit, because it represents the state of the art in V/STOL of about three years ago.

Hawker has not commented on any of the aircraft design changes, but some of these can be determined from study of the photographs.

#### Design Departure

Latitude in the P-1127 is a departure from the family resemblance of the last two fighters designed by Hawker engineering teams under the direction of Sir Sidney Green. The high wing has large negative dihedral and a nearly straight trailing edge seen in previous Streamline angles at the order of 15 deg., and the platform taper ratio is about three.

Wingspan is 24 ft 4 in. Conventional aircraft are fitted for lateral air flow strings, but because flight, it appears that tail-surface slats are also fitted for flight operations where wing control is required and landing is questionable, presumably because of aircraft overheat.

Leading gear is a tandem installation, with two main wheels at the front, the center of gravity, and a single nose wheel forward. Retraction of the leading gear is into the fuselage, which leaves the wing structure completely free of controls and reduces its static load weight to a minimum. Dragging gear is fitted to the wings and retracts directly into a housing.

Intake is 11 ft 2 in. long overall. Vertical and horizontal tail surfaces are minimum size, horizontal tail is the slab type.

Third vertical fin area is added to give the fuselage additional static directional stability.

#### Reaction Control System

Most difficult feature to analyze, from the pictures, is control surface of the plane. The most obvious are two nozzles under the nose and at the intersection of the vertical and horizontal tails. If general design pattern is as follows, the primary aerostatic control system of the Short SC 1.15W (Oct 12, '71) those has-aft nozzles are used for control in the pitch plane. Other openings shaped like reaction control nozzles are visible on the sides of the fairing for the forward engine exhaust nozzles, and on the wing leading gear fairings. Either of these, if they are nozzles, could be used for roll control.

Two control nozzles are not apparent and can be viewed as part of the reaction control system. There is a pair of nozzles on the top of the fairing, one on each side of each panel, which might exhaust air lines leading to nozzle nozzles for yaw control. An alternate theory would be to view the nose and tail nozzles as so that lateral components of the vertical control thrust would produce a yawing moment.

Bristol Siddeley BS-51 powerplant is a forced air engine which develops both fan and engine exhaust through four reversing nozzles, two forward for the fan and two aft for the engine. These nozzles have internal guide vanes

to route the flow through nearly 90 deg. to the plane of the nozzle exit. The nozzle can be rotated so that all the engine and fan thrust is directed at an angle from a few degrees forward of the vertical to straight.

Blunt of the engine is the lightweight Dylex noseplow. The fan ducts, was adapted from the first three experimental stages of Bristol Siddeley's Gipsy Major Engine. Engine diagrams added an extra low-pressure turbine in the base Dylex nose to drive the fan duct for the first stage.

Boasting from the fan is quite to go partly through the engine and partially around it and out through the forward jet nozzle.

#### Engine Thrust

Estimated overall thrust of the engine at 15,000 lb, but the best estimate is that the engine is running well below its design figure, perhaps at 12,000 to 13,000 lb.

The large resulting mass of jet engines produces geometric coupling effects which are a part of the aircraft's performance. There is a pair of nozzles on the top of the fairing, one on each side of each panel, which might exhaust air lines leading to nozzle nozzles for yaw control. An alternate theory would be to view the nose and tail nozzles as so that lateral components of the vertical control thrust would produce a yawing moment.

The engine has been running on the ground for the past year, the result being the Hawker aircraft in its first appearance in a flying vehicle. Development of the engine has been directed by the Material Weapons Development Program.



*Bell's All-weather Automatic Landing System—synchronized*

## CLEARED TO LAND, WEATHER OR NOT

Today's increasing air traffic demands faster and safer all-weather operation at every airport.

Bell brings this goal one important step closer with its All-Weather Automatic Landing System (ALS) which can fly two airplanes to touchdown every minute, even when visibility is absolutely zero.

The Bell ALS takes over when the pilot brings his plane through the electronic "window in the sky" and guides it to a soft and safe landing.

The system has been flight-proven in more than 4,000 landings with all types of aircraft—small private planes as well as airframes from the DC-3 and DC-7 to the huge Boeing 707 jet. It now is being evaluated at FAA's National

Aviation Experimental Center, Atlantic City, N.J.

Unlike other automatic landing systems, the Bell ALS is ground-based to a ground observer monitors every approach and landing. It can operate either fully automatically or under pilot control.

Military versions of the ALS have been ordered by the Air Force. The Navy has selected it for installation aboard the nuclear-powered aircraft carrier USS Enterprise as well as for its other large carriers.

The Bell ALS is but one among many contributions which Bell Aerospace Company is making to the strategic program and defensive strength of the free world. We invite qualified engineers and scientists to explore about sharing our challenging and rewarding future.



**BELL AEROSYSTEMS COMPANY**

BUFFALO, N.Y.

DIVISION OF BELL AEROSPACE CORPORATION

A TECNION COMPANY



## Virtually No Speed Variation From -67°F to +167°F Due To Special Dry Lubrication Method

### Type 1001-03 Size 5 2800C permanent magnet timer motor or motor tank

- 1/8" diameter 1000 C dual shield, 1000 G stainless steel.
- Motor tank or timer, peak load over 1000 G.
- Stays good in parture 2000 duty cycles at 1000 rpm, 1000 G.

• 1000 G shaft diameter reference.

• 1000 G = 0.00001 shaft diameter.

• 1000 L height of tank, 2.000" H.

• 1000 T tank weight, 1.000 lb.

• 1000 T-44 1000 G peak values available.

GEAR RATIO	DEPTH (in.)	LOAD	AMPERE AT 35°C	LEAD LENGTH	GEAR TYPE NO.	FIGURE 10 ELECTRICAL SCHEMATIC
40000 to 1	0.25	200 G max	0.005 max	1.300	1000	
40000 to 1	0.25	300 G max	0.006 max	1.300	1000	
20000 to 1	1.0	100 G max	0.111 max	2.000	1000	
20000 to 1	1.0	100 G max	0.111 max	2.000	1000	
10000 to 1	1.0	100 G max	0.225 max	2.000	1000	
4000 to 1	0.75	200 G max	0.500 max	2.000	1000	
2000 to 1	0.75	300 G max	0.500 max	2.000	1000	
1000 to 1	0.75	300 G max	0.500 max	2.000	1000	
333.3 to 1	0.75	300 G max	0.500 max	2.000	1000	
100 to 1	0.75	300 G max	0.500 max	2.000	1000	



RIGHT: Electromagnetic model  
shock wave assembly to help take  
care of your immediate requirements. Call your nearest Oster  
Oiler-Electric company.

*John Oster* MANUFACTURING COMPANY / Subsidiaries in Indianapolis and Greeley, Kansas; Boston, Berlin, Wiesbaden

Borehole  
dynometers  
Resistive  
Water Tanks

Compressors  
Dynamometers  
Dense Medium  
DC Motors

### EASTERN OFFICE

200 Franklin Blvd.  
Grove City, Long Island, NY  
Phone: 516/275-7000  
TWA: 516/275-7000

### WESTERN OFFICE

1000 South Broadview Rd.  
Grove City, Long Island, NY  
Phone: 516/275-11734  
TWA: 516-275-11734

Engineers for Advanced Products,  
Engineering, consulting work in developing  
borehole-dynamometer and resistivemeters  
Contact: Mr. Dennis Hansen, President,  
Ooster, Inc., Indianapolis.

## Senate Space Group Urges Effort To Settle Communications Issue

By Philip J. Klass

Washington—Immediate research is needed to resolve the question of possible interference between terrestrial and communications satellites and communications space vehicles has been recommended in a staff report to the Senate Committee on Aeronautics and Space Sciences.

The report, entitled Policy Planning for Space Telecommunications, also calls for immediate consideration of the implications of recent Federal Communications Commission decisions on the availability of radio frequency spectrum for space communications.

In October, FCC denied a petition by the American Telephone & Telegraph Co. and other telephone carriers, that it set aside an entire division to allocate frequencies above 950 mHz for private microwave system users—frequencies which AT&T had well selected for communications satellite service. In the related decision FCC denied the request for reconsideration and is believed that it believed the best type of service could co-exist without interference problems.

### Senate Notification

The most immediate space telecommunications user that will feel the FCC's decision soon is, the report points out, systems radiation by the Soviet Union based on frequency allocation agreements reached at the recent international Telecommunications Union conference in Geneva. These include the four limited frequency allocations for path-to-path radio measurements.

The treaty, submitted by the Soviet to the Geneva in June 9, will be voted on in March 1963 if decided by the Soviets. The staff report urges no comment by the Senate that should not receive Senate approval.

The staff report does cite these operations, however, which merit consideration and possibly investigation by the Congress.

• In the National Aeronautics and Space Administration program for communications satellites "boring" pursued with the vigor and enthusiasm that the form of global communications appears to possess". Also, in their adequate coordination between NASA and Defense Department on their active communications satellite program.

• Have the international implications of communications satellites, particularly their potential use by the less well de-

veloped countries, been evaluated by the State Department and NASA?

• Are steps being taken to effect coordination and support of other nations in setting aside radio bands in the radio spectrum for space users? The report points out that at the recent ITU meeting in Geneva, the U.S. was the only country that came prepared with proposals for frequency allocations that were not only for Soviet and the USSR, there was little agreement among the use of the radio bands. Although frequency plans are to be made available at the Extraordinary Ad-hoc Radio Conference in 1963 considerable effort must be devoted to ensuring other nations that this can benefit from the communications satellites.

• What is the role of private enterprise in telecommunications satellites and to what extent should U.S. companies be free to enter into cooperative agreements with other nations or space users? Should common carrier follow the pattern used for long distance radio and television cables?

• What will be the function of national federal agencies in the task of securing space agreements and assuring the implementation of government agreements for space communications satellites? In the past the FCC has had the authority directly for licensing private applicants while commercial service agreements are for licensing government entities agreements with the International Telecommunications Agency (ITU) which reports to the Director of the Office of Civil and Defense.

## Nuclear Facility Design Award Due

Washington—Contract to design National Nuclear Rocket Development Study will be awarded soon, and leading contenders are Aerojet General of Azusa, California Co., a Rockwell International Rocketdyne firm, and a joint Avco-Thiokol Chemical Corp. team.

• Award of the four-year National Aeronautics and Space Administration contract follows a bidders conference, Oct. 7 at the agency's test site, Jacobs Field, Fla. No. Representatives of 51 firms attended the conference and 12 submitted proposals for the design contract, which will be worth several hundred thousand dollars.

Definitions of facility requirements will be the contract's initial task, and early estimates put the construction and administration cost between \$15-550 million.

Volunteers. In the past, these two agencies have been to almost frequent within the framework of international agreement. With the advent of communications satellites, two new government agencies enter the picture: the State Department and NASA. The authority and area of responsibility of each of these agencies in the field of satellite communications requires re-examination and possibly redefinition, the report suggests.

### Coms Proposed

If the U.S. hopes to obtain additional radio frequencies for both space experiments and operational communications, it will not be easy. In the case of the 1961 ITU conference, there was little data available on the frequencies that are suitable for space; the bandwidth required and the feasibility of channel sharing the report notes. To date, the U.S. has been marketing spectrum data and data.

The Soviet bloc has not reported the allocation of additional frequencies because it controls over 10 large land areas does not appear international agreement in the extent needed by the U.S. and other countries, the report points out.

The U.S. will need to engage in negotiations and advanced preparations to convince other ITU member nations of the benefits of space communications.

The report points out that most of the new African nations can not communicate directly with each other, but must use radio or cable circuits which go through London or other European cities.

A single communications satellite over Africa offers attractive possibilities for providing a link between all African nations.

Site consultation also is a study required with Ireland. This has considered the west bank, the Aran Islands, Fingal, manager of the Aran Energy, Communications NASA, Nuclear Propulsion Office, recently told a research group that the national test facility will make maximum use of existing test facilities at the AEC's Nevada site.

Design study will be the basis for a larger master plan, which will be prepared by Fingers' office.

Installation will be NASA's, with AEC responsible for erection. No decision has been made as which NASA center will manage the facility, but it is expected that agencies will be drawn from both Lewis Research Center and Marshall Space Flight Center for the new test facilities.



# CAB Explains Its Rate-Making Techniques

Board outlines approaches to help weaker trunks; they include subsidy, higher fares, route changes.

By L. L. Daly

Washington—For making its point program that establishes new guidelines for bolstering weak domestic trunklines has been protracted by the Civil Aeronautics Board in its final discourse in the General Passenger Fare Investigation.

For the first time since all domestic hauliers became subsidy-free, the Board formally suggested it will again resort to subsidy for less profitable trunklines as part of its new program—where the interests of economic postal service and the carriers' interests are served. It also stated that readjustment of competitive costs may be a solution to the poor earnings character of some trunk lines.

Reported throughout the 72-page document, the Board referred to the unstable condition of the industry resulting from financial and other problems created in the transition to jet equipment. It said it could not establish interline standards until the industry has reached a more stable period.

## Difficult Problems

In its discussion, the Board admitted that "the problem of accommodating the requirements of the weak and strong carriers is one of the most difficult to be found in regulation." It added that general fare increases are not necessarily the pattern "that will solve this problem and it has evolved into new policy by suggesting these four tools for dealing with less profitable carriers:

- Overall coordination of the general passenger fare structure which might result in bringing the costs and revenues of individual carriers into closer alignment. An up-to-date study of the industry's costs and revenues over leading the cost structure was developed from the time considered in the Civil and Passenger Fare Investigation, but such survey was never conducted.
- Carriers whose needs are not much less than substandard can set higher fares. The Board admitted, however, that competition would probably prevent carriers from charging fares higher than the established level except in marginal areas.
- Readjustment of routes to produce a more balanced competitive route structure.
- Subsidy payments when the Board finds that such compensation is required to the interests of economic postal service and postal rates.

Joseph Minot, who concurred

in the Board's report, would earn 11.25%.

The Board decision does not provide a guarantee that the industry should group, can a weighted average of 10.5% rate of return over the standard is based on long-term stability and the Board wants to avoid adverse influences when the industry's current fiscal position is considered. The long-range Profitability was 10.99 for the 12 trunklines with 25%, but they had dropped to 4.6% in June, 1958. The Board undoubtedly will drop substantially when studies for the first fare quarter are fully advanced.

## Marketing Inhibitions

Carriers are strong that most carriers will be subject to it. In a fair revenue at this time, despite a leveling-off of recent growth, would not likely be in the rate of the very short-run handicap of overcapacity, even in high density traffic routes.

Some carriers are interpreting the Board's decision to imply that it will continue to favor fare increases and that the competitive factor will run out of the decision in open markets to compete with the cost of the industry. The industry has traditionally held that it should be granted the privilege of determining its fare level within a range determined and fixed by the CAB. As a result the interpretation may be so fully shared that it's hard to see if the future of the future.

In the decision, the Board gives no indication that it is ready to allow the weak carriers are well free from setting a rate level other than to say that "a carrier whose needs are not well be granted fare level adjustments can set higher fares." On the subject of cost and fare structure, it does note that "it is clearly not the function of the Board to assume the role of manager and inhibitor in judgment that of a carrier which is in conflict with the perspective of management." It is indicated it was provided from negotiations on the basis of policies discussed from factual findings, but added:

"On the other hand, the Board is under statutory injunctions on determining rates to consider such factors as "the need in the public interest of adequate and efficient transportation of persons and property by air carriers at the lowest cost consistent with the furnishing of such services, the promotion of ade-

quate seasonal and efficient service to air carriers at reasonable cost, and the need of such carriers for revenue sufficient to enable such carriers, on the basis of economic and efficient transportation, to provide adequate and efficient air service areas."

In his decision, G. Joseph Minot, who recently has been frequently mentioned as a leading candidate for the Board chairmanship, expressed fears that increased fares will depress traffic but emphasized that no one observes appears to agree on the exact fare level where this will occur. On this point, Minot said:

"... if the present cost levels prove to be permanent, other than temporary, then the currently high fare levels would be maintained whenever the effect of the rate on the movement of traffic and on utilization of the industry's capacity and anticipated future availability. If rates, however, prove to have been only temporarily inflated, and a soaring fuel cost force levels to reflect traffic growth, we will be able to take action to reflect fares to a point consistent with representative cost levels and with reasonable traffic growth in the degree measure, so profitable operation is possible."

Minot said he would grant an 8.75% rate of return for the Big Four and 9.0% for intermediate carriers as reasonable and ample.

How are the weak carriers brought into the Board's final decision on costs and rates of return?

The Board's final decision regarding fare regulation should be on the basis of the cost of the fare base, depreciation and taxes. However, the Board declined to fix a rate level because of future operations by the industry are hard to be consistently reliable which for such purposes.

• Industry profit should be regulated by the conventional test of rate of return on investment rather than by the operating site or its competitive return margin. The Board found that the rate of return which return to capital investment in amounts sufficient to compensate for the capital invested in the business. It added that operating ratios which a rate return on investment gives no due to the return required to pay capital costs and return new capital.

• Rate of return of 10.25% is to be allocated the Big Four carriers is derived from the averaging at 4.5% cost of debt and 16.0% cost of equity, in a capital structure consisting of 50% debt and 50% equity. Rate of the intermediate eight airways is based on the averaging of 5.5% cost of debt and 15.0% cost of equity to a capital structure consisting of 25% debt and 75% equity. Debt costs agree with those recommended by Economic Ralph E. Wiser, but the Board's cost of equity

rate differs slightly from Wiser's rate. The Board has to be used for the industry should consist of net working capital, net operating property, and equipment after deduction for depreciation, net working assets, and other working assets, including equipment purchased in progress.

• Depreciation charges on flight equipment should be based on a seven year life and 15% residual value for passenger aircraft, aircraft and surface. Depreciation charges for surface property should be based on a 10 year life and 15% residual value for aircraft and a five year life and 15% residual value for surface property. The Board said 5% of surface costs should be apportioned on the standard value in the ownership allowance. On this point the Board has indicated the Bureau Economic's proposal that a flat depreciation charge of 4.5% is not available and will be replaced by a rate which will be applied in the same manner as the Bureau's experience for the three period, 1946-1957. It also disapproved the practice taken by most carriers that the Board was required to accept industry's depreciation rates and figures unless shown to represent fair value, a profitable approximation.

• Federal income tax expense, including the cost of interest purposes should be based on normal tax paid under straight-line depreciation rather than under permissible liberalized depreciation methods.

• In determining fare adjustments, the Board will give consideration to the extent to which the fare level meets the cost of the Big Four and the intermediate eight carriers. Fare adjustments not will be based on the results for the industry as a whole, and not for the smaller carriers or the financially weakest carriers.

## Imminent Certification Seen For BEA Vanguards; TCA's Delayed

London—Vidco is awaiting full passenger-carrying certification for BEA Vanguards by Sept. 1. It has the Air Registration Board. It expects to be able to offer the engines at delivery with an overall life of between 400-500 hr., according to Wm. J. Wren, London.

Certification for the Vanguards is expected to be completed in late September, due to engine problems in the Cheetah engines.

BEA has already planned to use the Vanguards on its routes here on the London-Paris run over the Channel. But full scheduled operations are not due to start until May 1 when the aircraft will be used on British internal services, said Wren. By this time, aircraft life may be higher.

Vidco CAPED fitted with the fully modified production. The engine completed the 200-hr. engine "start and stop" problem on Oct. 31. Flying a simulated enroute pattern involving three or four trips per day, as done a week, the aircraft completed the 200 hr. in 10 days.

Two of the engines were stopped in

order to inspect all facets of future operations by the carriers and the Airline Council on grounds that the carrier revenues of 1957-1958, the areas of study preceding several carriers in 1959 and 1960 and the transition to turboprop power, compared to jet power, is a major factor in the future of the transatlantic trade. The Board found that the industry's forecast of 27.5 billion passenger miles for 1958 and 31 billion for 1959 left for short of actual results of 26.6 billion in 1958 and 25.1 billion in 1959.

• Board refused to accept proposed standards concerning load factors and cash costs because of the unstable nature of the industry at the present time.

• In setting fare levels in future cases, the Board will stipulate rates to produce a reasonable return over an extended period of time. It said that the carriers' ability to permit fare adjustments "cannot be guaranteed" and that the Board will not be held liable for any damage to a carrier's business if the Board acts on a case-by-case basis, applying informed judgment to the basis of balancing the relevant factors."

• In determining fare adjustments, the Board will give consideration to the extent to which the fare level meets the cost of the Big Four and the intermediate eight carriers. Fare adjustments not will be based on the results for the industry as a whole, and not for the smaller carriers or the financially weakest carriers.

• An Registration Board. The other two were transferred to Vanguards G-APEL and subsequently joined another configuration after 250 hr.

It is understood that both Rolls-Royce and the ABE were sufficiently impressed with the development of the engines to start the engine with the same number life as that of aircraft was authorized for the Duct. Start in August 23, 1958, the Vanguards will begin flight 1,000 hr. by the beginning of 1960 and the 12 aircraft now flying have run over 2,000 flights.

The program is delivered for six months is a straightforward task in the conductor data (IAW) June 4, p. 45). Atypical decisions by the TCA. TCA's decision to be Vanguards G-AQWV, the first development aircraft to be fit with the re-engineered aircraft to effect aircraft performance. That aircraft has completed nearly 400 hr. during 300 flights.

Apart from the atypical the Collins Light Eight has been fitted with all associated radio gear and the necessary flying configuration up to 135 pax. 196 has been completed.

## Boeing 727 Productions

Boeing Aerocar Co. is expected to announce the week that it will build the Boeing 727 triple-jetliner transport based on American Eastern and United Air Lines' (UA) New York City. Boeing probably will use an appearance next week before the New York Society of Security Analysts in a forum. Press plans will be Pratt & Whitney (P&W)



FIRST CONVAIR Model 990 jet transport is rolled out of the plant at Lindbergh Field, San Diego, Calif. General Electric CJ801-21 alt. for

## Convair Rolls Out First Model 990 Jet;



CONVAIR 990 wing has a leading edge sweep of 10 deg. and wing inlets from speed reverse to reduce drag.



CONVAIR 990 is flattened to avoid interference with down wing surface flow. Flattening the bottom tail makes possible a longer tail span.

## Testing Begins

By Russell Hawken

San Diego, Calif.—First Convair 990 jet transport aircraft, designated the Convair 600, has been rolled out and is scheduled to make its first flight on Jan. 15.

Ground testing of the number one Convair 990 jet transport aircraft is to be completed at Lindbergh Field here. These older aircraft will join on the Federal Aviation Agency's aerobatic certification test program and another will be used for vibration stress testing.

The 990 is to be in service with airlines in 1961. It will be built in two versions, the basic 990 for domestic service and the Convair 990 for intercontinental routes. Convair has an option to add a total of 17 firms under the proviso. American Airlines has ordered 23 of the domestic version and Convair has been selected by Swissair (1), Scandinavian Airlines System (2), Royal Air Force (20), and British (15). Trans World Airlines is expected to get six in addition to those ordered (ADM Nov. 25, p. 70).

The 990 has a maximum cruise speed of 540 mph, which is 25 mph faster than the earlier Model 990. Convair estimate at least 10 percent for 540 mph cruise speed. Most of the speed improvement is due to the installation of General Electric CJ801-21 turbines engines, each rated at 16,100 lb. thrust, and to a radically new high speed design.

The most obvious innovation in the new wing design is addition of four



GENERAL ELECTRIC designed the fluid system which are fired into the pit when retracted. Double-slotted Fowler flap extend beneath the wings.



MODEL 990 can carry up to 121 passengers in layout configuration. Cabin superlong seats are built just below the wing root leading edge.



## Confidence counts and the airlines count on Sinclair

45% of the aircraft oil used by major scheduled airlines in the United States is supplied by Sinclair. Military jets also count on Sinclair to supply Sinclair Aircraft Oil to lubricate their mighty engines. There is no better proof of reliability.

**Sinclair** AIRCRAFT  
OILS



Sinclair Refining Company

Aviation Sales, 600 Fifth Ave. - New York 20, N.Y.



**CONVAIR 990 TRANSPORT** is 179 ft. 5 in. long and 39 ft. 6 in. high. Wingspan is 112 ft. Note canard thrust avionics.

streamlined ailerons on the upper surface of the wing extending off the trailing edge. The ailerons first demonstrated experimentally by agents of the National Aeronautics and Space Administration, are called speed capsules by Convair engineers (AW Sept. 3, 1958, p. 93). The capsule, which is the thinnest wing being used as a control element, is located at the wing trailing edge, just off the surface to maximize their influence on roll. Along the line of the center of the wing, the movement also allows working pilot controls to extend beneath the capsules.

The inflated capsules are 28 ft. long and the deflated capsules are 24 ft. long. Maximum thickness of the large capsule is about 2 ft.

Streamback of the 990 wing is 16 deg. at the leading edge. Convair officials call it the leading wing being used as a control element. Leading edge slats which are extended at the same time as the trailing edge flaps postpone surface separation to higher angles of attack, enabling planes to take off and land in much higher winds than heretofore believed and landing distance requirements.

Wingtip trailing edges are slightly modified to extend beneath the capsules.

The inflated capsules are 28 ft. long. Deflated flaps are

double-slotted, full Fowler motion type. Dualcan ailerons are also double-slotted with full Fowler motion.

Coming down the 990 can land and take off from most airports used by four-engine propeller-driven transports, which would make jet aircraft available to more cities than long-range large enough to handle the jet now being used in airways.

Convair officials report that the modular replacement philosophy of military avionics has been adopted in the 990 to keep down the cost and weight of the aircraft. Access doors are at 17% of the fuselage width and about 35% of its length, giving surface to specific removal of parts and the installation of replacements. Dual canards are used as engine pod wing-pylon and structural attachment.

The General Electric turboprop engines are reported to be 40% more efficient than the industry's 17% target on which they are based. Diameter of the canard pods is nearly 8 ft. 9 in. Dual canard thrust is taken down the external surface of the side of each engine pod when the aircraft is in the cruise position. Moving inboard, the engine, canard and the low velocity air entering the fairings with the engine pods, creates a downward force on the canard pods.

The basic 990 carries 15,110 gal. of fuel. The Convair 990 carries 15,675 gal. and has full provision for emergency storage. The fuel capsules on the wings are used for fuel storage. The 990 can accommodate 90 first-class passengers in four abreast seating. 121 passengers in first-class seating, or about one-half as many in round seating arrangements. The cabin fittings are designed to fit the airline operator's choice of first-class and coach seats in cabin size and width.

At 40,000 ft. the cabin of the 990 can be pressurized to the equivalent of 6,050 ft. At 20,000 ft. cabin pressure can be adjusted to 10,000 ft. Minimum cabin pressure differential is 8.7 psi.

## Convair 990 and Coronado Specifications

### Performance

Cruising speed	640 mph
Rings (full fuel/takeoff payload, normal reserves, at long range cruise, at 31,000 ft.)	4,061 stat. mi.
Stalling speed (flying configuration)	197 mph
Maximum cruise altitude	40,300 ft.
Rate of climb (no level power, takeoff weight)	3,219 ft./min.
Fuel consumption (30,000 ft., average cruise power)	1,010 gal.
Takeoff CARGO capacity for 7,000 stat. mi. trip	5,156 lb.
Takes off CARGO capacity for 1,000 stat. mi. trip (no level, standard conditions)	4,608 lb.
Landing CARGO capacity	3,778 lb.

### Capacity

Passenger oil fuel (off centerline 120)	96 gal.
Defuel (off centerline 120) 20,245 lb. (maximum)	25,720 lb.
Defuel (Convair 10,657 lb.)	13,119 gal.
Gd	26 gal.
Gage	500 lb. ft.

### Description

Wing span	112 ft.
Wing area	2,280 sq. ft.
Length	179 ft. 5 in.
Height over tail	39 ft. 6 in.

### Weights

Maximum landing weight	188,800 lb.
Maximum takeoff weight (Convair 244,265 lb.)	259,265 lb.
Maximum empty weight (Convair 245,000 lb.)	246,900 lb.
Maximum zero fuel weight	154,000 lb.

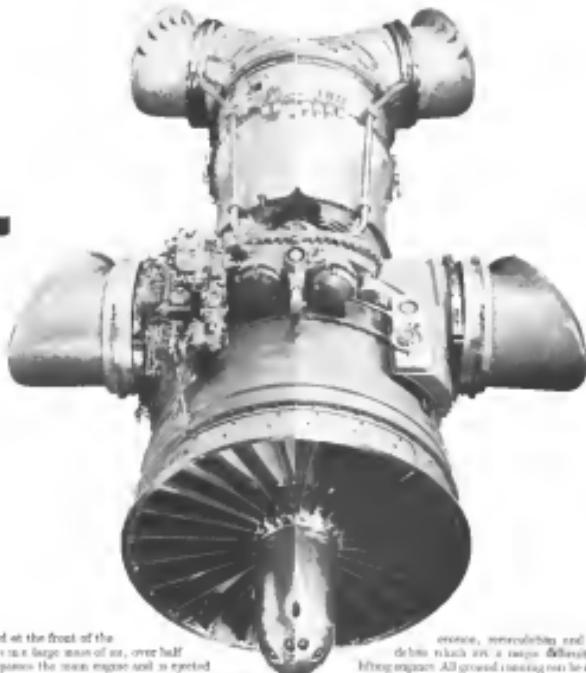
### Engines

Four General Electric CJ800-33 off-thrust jet engines equipped with thrust reversers. Engines rated at 16,100 lb. each.





# LIFT AND THRUST FROM ONE ENGINE



**A single power source for VTOL and STOL aircraft.** The new Bristol Siddeley BS 53 high-bypass turbofan represents a major engineering leap forward in the field of VTOL and STOL aircraft propulsion because it provides the aircraft designer with a single power source for all conditions of flight.

**High cold-flow ratio, high thrust, low fuel consumption.** The most revolutionary feature of this unique engine is that the thrust can be evenly applied around the centre of gravity through four moveable nozzles which can direct downwards in flight, upwards for thrust, downwards for landing, or in any intermediate direction. The unique possibility, for the first time, of the design of single or multi-engined aircraft on a design that is not limited to conventional for vertical or short take-off with a much payload comparable power as existing today.

**Conventional control ideas, operational simplicity.** The BS 53 is installed axially, with forward facing nozzles and the simplicity of its components are based on well-known principles already proven in service. These factors make for operational simplicity, easier maintenance, greater reliability.

**Reduced problems of ground-erosion and re-ignition.** Because the velocity and impingement of its jet effluents are low, the BS 53 minimizes the problems of ground

## THE REVOLUTIONARY **BS 53** TURBOFAN

debris which are a major difficulty with fixed lifting nozzles. All ground running can be done with the exhaust striking hardstands like a conventional turboprop. Take-off also is perfectly normal, and at take-off a short forward roll before the nozzles are deflected downwards ensures that all debris is left behind. As a result, the BS 53 does not require prepared sites and is independent of all fixed ground conditions.

**Selected for the world's first VTOL fighter.** The Bristol Siddeley BS 53 has received the support of the British Weapons Development Programme for X-ARD and has already been selected for the world's first fixed-wing aircraft designed for operational success with VTOL capability—the Boulton Paul P.1127. Although this remarkable engine was primarily designed for this type of aircraft, it is equally suitable for any single or multi-engined subsonic or supersonic aircraft which requires VTOL or STOL capability.

**...ANOTHER ENGINEERING ADVANCE  
BY BRISTOL SIDDELEY**



**BRISTOL SIDDELEY ENGINES LIMITED**

# AIRLINE OBSERVER

► Airline traffic volume may be developing an unanticipated but unfortunate rise during the last six weeks of 1968, following five months of depressed activity (AW Nov. 21, p. 31). Heavy passenger load factors coupled with relatively good weather probably accounts for the slight upward trend.

► Convair 880 has now been officially designated the Convair 990 by General Dynamics Corp. (box p. 40). The change was made without fanfare in a press release on the 880 variant, and that is about as far as the manufacturer plans to go in making the redesignation official. Originally, Hawaiian Airlines chose the number 880 for the last of Convair's jet transports, and insisted that no higher number be used for subsequent aircraft. Later, American Airlines ordered the more advanced 880 and decided to call it the 990. Swisher calls its unchristened 608 the Convair.

► Federal Aviation Agency is highly encouraged by initial tests on its ship board Vortac geodolite, intended to evaluate feasibility of establishing a standard of search acquisition rate on weather maps across the Atlantic. Measurements on the initial slanted-mastitude geodolite navigation errors of less than three degrees, comparable to those obtained with land-based networks. Airlines will begin to use the ship-based Vortac soon on a real basis.

► American Airlines will add extra coach seats on its Boeing 707 fleet to increase capacity during the peak holiday traffic period Dec. 16 to Jan. 7. The 707s will operate with 80 coach seats and 45 first-class seats, compared with current configuration of 68 coach, 36 first class. 720s will have 60 coach seats, 36 first class, compared with the present arrangement of 50 coach and 45 first class. Temporary reconfiguration of seats is based on expected increase in demand for coach seats by passengers traveling for personal reasons and a seasonal decline in those traveling for business.

► Canadian CL-44 minimum requirements for both takeoff and landing have been improved 13.42% over earlier theoretical figures as the result of recent flight test measurements. Balanced field length for balanced takeoff minimum gross weight of 265,000 lb is reduced from 7,668 ft to 6,640 ft. Landing field length or minimum gross landing weight of 165,000 lb is reduced from 6,780 ft to 5,930 ft.

► Federal Aviation Agency has been asked to make a simulation study of air traffic control activities on the Berlin terminal area by U.S., British and French forces in the German city. Full-scale study will be conducted with a dynamic air traffic control simulator at FAA's Bureau of Research and Development's Experimental Center at Atlantic City. Although Berlin's air traffic is not heavy by U.S. standards, British space, the need for more modern navigation aids and control equipment and the confinement of traffic to three corridors between Berlin and the West have created problems in the handling of air traffic in the terminal area.

► Aeroflot's Tu-104s continue to show poor utilization after more than four years of regular service. One Soviet source indicates that Tu-104s explored on the Transiberian run average only 150 hr of flying time monthly.

► Northwest Airlines has been making the best of a bad situation resulting from the flight engineer strike which has grounded the carrier's Douglas DC-9 subjet transports. Thirty of its DC-9s had been sent back to the Douglas plant for fixes during the strike. These include installations of leading edge wing tanks and air curtains for the aircraft. Northwest's fifth DC-9 will come from the plant with the modifications already completed.

► Air Traffic Conference last week elected William J. McKeefry, vice-president of traffic and sales for Braniff Air Lines, president of the conference. William L. McKeefry, Jr., Eastern vice-president, was elected first vice-president of the organization, and C. Gardner Brown, vice-president of Pan Am Airlines, was named second vice-president.

## SHORTLINES

► Air France has begun winning Sud Aviation Caravelle turboprop service from Paris to Prague, replacing Vickers Viscounts on the route. The French carrier recently took delivery of its 28th Caravelle and increased its order for the twin turboprop from 27 to 31.

► Air-India International has been recommended by a Civil Aeronautics Board committee for shipper rights at Duluth and Sault Ste. Marie, as flights from India to the U.S. Duluth also is served by Trans World Airlines, which had no objections to including Air India in the Sault Ste. Marie market.

► Braniff Airways incorporated an all-cargo service last week between Dallas and New York with Douglas DC-6A equipment. The airline has organized a new cargo sales and service department to put new emphasis on cargo and freight services.

► Capital Airlines has authorized by the Civil Aeronautics Board to expand service at South Bend, Mich., Cleveland and Traverse City, Mich., Dec. 1 when North Central Airlines began serving the three cities. Action was part of the decision in the Great Lakes Local Service Case.

► Continental Air Lines has asked the Civil Aeronautics Board for shipper rights between several Texas cities in the Southwest Local Service Case hearings now in progress in Washington. Continental is asking for authority between Dallas, Worth and Houston and Dallas/Ft. Worth, Austin and San Antonio.

► Federal Aviation Agency has organized an Aerospace Defense Planning Section to develop technical guidance for shipper participation in national emergencies plans.

► Mohawk Airlines has been recommended by a Civil Aeronautics Board committee for shipper rights to operate nonstop between Syracuse and New York. The recommendation follows a trial period of three years during which Mohawk's participation in the nonstop Syracuse-New York market rose from 8,013 to 14,314 passenger enroute.

► Montreal International Airport opened its new \$30 million facility last week. The new terminal complex and a new 7,500-ft runway will serve the four Canadian and eight international carriers operating from Montreal. Eastern Air Lines and Northwest Airlines are the U.S. carriers operating at the airport.



## RELIABLE HUSKIE... WELCOME SIGHT IN MISSILE SUPPORT

The kind of support a missile site may need in an emergency may be technical, equipment, human or surveillance.

Regardless of weather, when support is needed, it is critical and it must be fast and reliable.

In its support missions, the Kaman HUSKIE can carry precious cargo inside, bulk cargo outside. Built by the people who pioneered turbine powered helicopters, the HUSKIE, already on duty with the Air Force all over the world, has the reliability, capacity, and versatility to become the vital link in the chain of missile site support.



pioneers in turbine powered helicopters

THE KAMAN AIRCRAFT CORPORATION •



BLOOMFIELD, CONN.

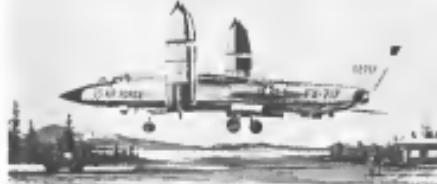
# AERONAUTICAL ENGINEERING



AREA-FILLED engine of the Bell D-188A Mach 2 V/STOL tactical fighter is shown in engine mockup built by Bell. Note the variable wedge that separates the inlets of the two General Electric J85-5s housed in the right wing tip nacelle.

## Bell Reveals D-188A V/STOL Details

By David H. Hellman



D-188A engine nacelles in V/TOVL. Right engine nacelle turned about 10° to its most aerodynamic angle for improved efficiency. Wing tip nacelles rotate from horizontal to 10° below vertical as required for forward flight, propulsive vertical thrust or landing reverses. Rotation of nacelles toward horizontal does not interfere with vertical air intake.



ALUMINUM plates capable of quick assembly could form the landing gear for normally deployed D-188A. But a right in-seat concept could transport gear and then when interrupted by the fighters' valid, gear function and deployment of the landing gear. Seats of Instructor which uses in the background hold fast. Bell found that aluminum is used, treated with resin compounds, could serve as a D-188A landing gear.

Buffalo, N. Y.—Disclosement of the Bell D-188A Mach 2 V/STOL tactical fighter, named second full-scale design stage by a 157-volunteeer-aerospace-company consortium, now hangs on Bell's success in winning military interest in the aircraft.

Valuing from an industry competition to design a deck-ride intercept for Navy and a former Air Force requirement for a V/STOL fighter-bomber (AW Mar. 14, p. 26), the D-188A project, Bell believes, could produce an operational evaluation aircraft in 18 to 20 months.

Bell maintains that this aircraft would be, in one sense, a prototype would do well in a short V/STOL design in performance. Projected, by eight General Electric J85-5 engines developing a total thrust of 25,000 lb on each, the D-188A could:

- Climb at least 60,000 ft/sec at sea level
- Cruise 600 nautical miles and return while holding Mach 2 at about 35,000 ft
- Accelerate from Mach 1 to Mach 2 in under 5 sec at about 15,000 ft
- Have a Mach 2 flight range of 2,000 nautical miles
- Maintain Mach 2 for 140 sec in a high speed intercept mission, then return from an altitude top of 65,000 ft at best cruise
- Take off from a short strip, cruise 370 nautical miles, then hold a Mach 2 flight for 175 nautical miles before a high altitude landing drop.
- Force and Navy have backed D-188A development to the extent of \$14.5 million, with the flow of funds



FRONT view of random choice one of the two off-engine nacelles which incorporate variable, wedge, and stable, high-mounted D-188A wing.

beginning in 1966 and ending in February, 1969. To avoid dissolving its D-188A design team at this point, Bell mounted another \$2.5 million—a sum it intends to write off if no new firm management is selected by the military.

According to Bell Defense Department's decision to continue or discontinue the D-188A program will depend, whether a supersonic V/STOL fighter of U.S. manufacture can within the next two years or not yield the 34% TAC. The timetable looks some time between 1970 and 1972.

At the winter meeting of the Air Force's Air Command and Air Force's overall implementation of Systems Design and Requirement (SDR) 12, which replaced the need for a Mach 2 V/STOL fighter and succeeded it with SDR 17, which calls for an STOL fighter with a 1,000-nautical-mile capability and a range of several hundred miles which would be below 12,000 ft at about Mach 1.

### STOL Given Priority

Discussions of Defense, industry, stated the Air Force's need for the V/STOL fighter as the STOL fighter and indicated that these might be called. In the light of these developed requirements, TAC headquarters is



COCKPIT of the D-188A features center panel with all engine instruments on its left, fire control and navigation systems on its right and radar displays at the center. All operating controls are in side panel or console. Vertical scaling engine performance graphs are in left side panel. Pilot seat has a vertical seat temperature and pressure of all eight engines. Radar altimeter provides a cross and center of power source indicator that reads to each power setting to show fuel remaining, center of power location and remaining range capability.



PRESSURE pattern presented to various wingroot configurations is shown above with black arrow indicating the degree of 30° or azimuth of V/STOL pressure. When at constant pressure from one normally pressurized outlet (AOA) as it is exhausted or pulled to form the inlet to create a suction effect at intake. Center diagram shows inlet condition with wing tip mounted propellers and its intake outlet. Drawing at right outlines D-188A pressure pattern in wind tunnel, with some suction effects resulting from flowage involving



the aircraft.



the aircraft.

# ROLLS-ROYCE

# GAS TURBINES

1,000

3,000

14,000,000

## civil aircraft

Over one thousand Civil Aircraft powered by Rolls-Royce gas turbines have been ordered by commercial operators.

## hours overhaul life

The 3,000 hour overhaul life of the Rolls-Royce Dart prop-jet is the highest ever approved for any aero engine.

## hours experience

Rolls-Royce gas turbines have flown over 14 million hours in commercial service. This total is increasing at the rate of 5 million hours per year.



## Now Min-K® is flexible!

THE INSULATION WITH A LOWER CONDUCTIVITY THAN STILL AIR IS NOW AVAILABLE IN BLANKET AND TAPE FORMS FOR UNLIMITED NEW APPLICATIONS

Min-K, the unique insulating material developed and produced by Johns-Manville, now has an added quality - flexibility. Min-K is a new concept in protective insulation. The higher it flies, the better it insulates. Min-K's thermal conductivity drops as atmospheric pressure decreases. Its superior performance has been proved in thousands of operational U.S. missiles.

Now flexible Min-K offers many special advantages. For example, it is the ideal way to cover sensitive parts of aircraft and missiles. The flexible blankets and thermoplastic coatings, however, are not restricted to insulation and as a component of ventilation systems. Further, Min-K can be tailored made to wrap around cylinders, cones or other noncylindrical shapes. And, it is also available in 15" and 2" tapes for spiral缠绕 on a duct or pipe.

Because of the added quality of flexibility, Min-K's unique insulating characteristics now can be used in virtually unlimited new applications. For full details on flexible Min-K, Min-K and other J-M aviation insulation, write Johns-Manville, Box 14, New York 18, New York. In Canada: Post-Point, Ontario. Cable address: Johnsmav.

**JOHNS-MANVILLE**  
**JM**



BULLPUP missile in firing position on one of the dual centerline trusses installed on the D-100A's fuselage. Hydraulically spreader trusses can hold two Bullpup or three Sidewinder or combinations of these with gravity drop weapons.

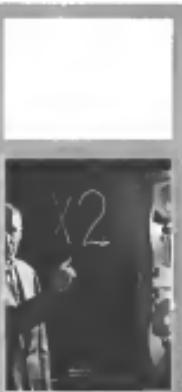


THRUST deflection valve on aft engine port permits straight line flight for forward flight, direct exhaust deflection for vertical takeoff and landing maneuvers. Note the fixed vertical position of forward lift engine in the drawing at left.

pace STOL aircraft to be on hand in sufficient strength about 1965, with VTOL fighters to follow sometime after 1970. In the interim, DOD intends to keep some VTOL "train planes" on existing military systems. And, it is also available on 15" and 2" tapes for spiral缠绕 on a duct or pipe.

Because of the added quality of flexibility, Min-K's unique insulating characteristics now can be used in virtually unlimited new applications. For full details on flexible Min-K, Min-K and other J-M aviation insulation, write Johns-Manville, Box 14, New York 18, New York. In Canada: Post-Point, Ontario. Cable address: Johnsmav.

Spectacular improvements in speed are being made in the building of the D-100A to be used for operational evaluation and also trials for a production VTOL fighter aircraft program that would include an engine deflection capability study. Using casting head



### How to double performance of your magnetic tape recorders

Now you can record 125 kHz data at 20 km instead of 10 on most tracking data recorders. How? By using the new Ampex FR 600 for playback. New record playback capability in the FR 600 makes previous requirement from tapeless recorders with tape added benefits of its own - for example recording 500 kc in 120 cps.

Your curiosity whetted? Write

**AMPEX**

ANALOG DATA PROCESSING EQUIPMENT  
Box 3000 • Redwood City, California



## D-188A. Specifications:

#### ANSWER

Adult female	
Body weight	28.947 g
Length weight	13.793 g
Length weight ratio	1.686
Length weight ratio, sex level	1.686
Sex	female
Sexual condition	reproductive
Food	30.836 g
Food weight/initial weight ratio	1.03
Food weight/initial weight ratio, sex level	1.03
Spawning	1.11.9%
Length overall	12.2 cm
Length total	11.9 cm
Length head	1.9 cm
Length body	9.0 cm
Length dorsal	2.4 cm
Length anal	4.2 cm
Eggs	
Weight GE	0.813 g
GE/EG ratio with shell/burster	1.830
GE/EG ratio without shell/burster	1.777
GE/EG ratio without shell/burster, sex level	1.777
GE/EG ratio without shell/burster, sex level, length	2.380
GE/EG ratio without shell/burster, sex level, length, weight	1.515
GE/EG ratio without shell/burster, sex level, length, weight, length	2.030
GE/EG ratio without shell/burster, sex level, length, weight, length, weight	1.710

SO&R-IT is Specific Operational Requirement (SOR) status, thus bringing it into the short term planning policy. Short term planning involves status 'which can be met without patient feedback, expandable and placed on the production'.

In September, Air Research and Development Command suggested Air Force to study how SDR 12 and SDR 133 (the old SDR 87) would substitute for planned programs.

## Design Features

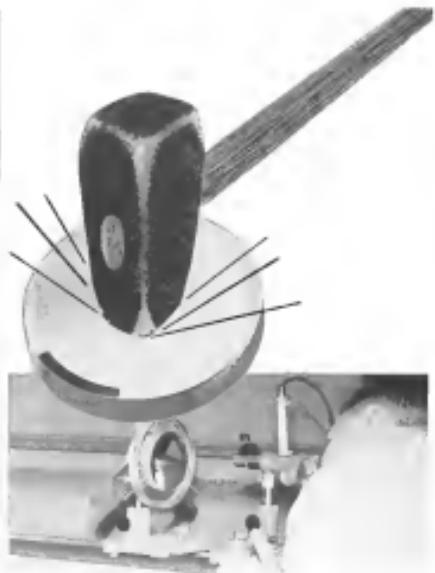
Up to now a highly classified paper at the Bell Aerostation Co. plant has

The basic D-1994 design incorporates eight conventional B-108 nozzles, two being horizontal and parallel to the rear fuselage, two in sponsons attached to each wing tip and two mounted vertically just aft of the cockpit.

All except the forward engine which furnishes lifting fluid rate is equipped with afterburners. During VTOL operation a modified layout provides ignition of the three engine afterburners regardless of thrust vector position.

During the vertical position, the main beam is tilted to 10 deg behind vertical as required for forward flight propulsive vertical thrust or banking action. In the vertical position, main beam and housing translate upward about 10 in. bringing the engine with two blades to improve VTOL efficiency. Rotation of the nozzle toward horizontal during the transition is shown.

- Reaction control system for use during VTOGs and transition flight phases. To control roll and yaw, compressed air from each engine pump is circulated to four variable-exit nozzles located through one of six outlet ports to achieve a reaction in the opposite direction. Pitch is controlled with a modulator that directs a subset of the



22,000 g's shock.

applied to this plane optics mirror at Singer Bindgarn. Here an engineering physicist in the optics lab inspects test sample. These Singer plastic mirrors, called Rap-Kote, are an important consideration in the state of the optics art, providing a flat, economical method of duplicating polished glass mirrors from epoxy resins. Currently work is going forward in replica optics under Franklin.

Today Stinger-Eriksson's skills in precision machining and exacting assembly work are at the service of the Military Anti-submarine Division, 3-inch mark assemblies are now in production.

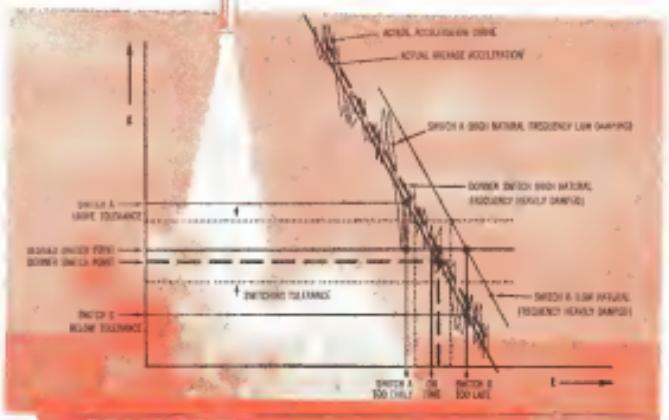
Industry, too, depends on Singer-Bridgeman as a partner, not just a vendor, in engineering and producing electronic and electro-mechanical systems and components.

Singer Bridgeport's comprehensive capabilities are detailed in a new illustrated brochure, *most for the asking*.

**SINGER-BRIDGEPORT**  
A DIVISION OF THE BRIDGE MANUFACTURING COMPANY  
(See Printers' Directories) 100 EAST 42nd STREET



# There's only one reason to specify Donner acceleration switches



## ..BECAUSE THEY UNDERSTAND THE MEANING OF ACCURACY



It's dynamic accuracy that counts. In truth, several firms make precision acceleration switches. But accuracy, like reliability, is a term with shades of definition. Some switches are accurate in the lab or on the test bench. That is, they provide *static* accuracy. Donner acceleration switches give you accuracy where it counts on the operational missile. They are dynamically accurate.

Look at the graph above. Under static conditions, switch "A" with a higher switching response, might be desirable. But suppose the missile were experiencing a 10 g vibration of a high frequency nature, and proper design cannot depend on a damping of 1.7 g switch point. Switch "B" would eliminate the possibility of early switching, but introduce undesirable phase shift which in turn would make the switch "A" the correct alternative. In other words, under the dynamic conditions of missile and aircraft flight, it is absolutely necessary to know when an event occurred rather than precisely where it occurred. Frequency response becomes a more important consideration than switch accuracy.

Highly damped, with a high natural frequency, Donner acceleration switches have low phase shift providing the transient response necessary to follow rocket engine

operation and perform their task with maximum accuracy.

**Donner Acceleration Switches are Flexible**

Because of the inherent flexibility of Donner's basic acceleration servo system and associated electronics, Donner acceleration switches will satisfy virtually any requirement.

Devices include multiple switch points, set specified damping ratio, built-in time delays to overcome initial transients or delayed output, memory damping, and total programming capability.



See Page Beginning on Report—For complete technical information, write for our new brochure, *Dynamic Response Devices for Aircraft Instrumentation*. Technical Information is available from Donner Scientific Company, 1000 West 23rd Street, Los Angeles 6, California.

**DONNER** SCIENTIFIC COMPANY  
A Division of System Design Corporation

CONCORD, CALIFORNIA • AIRPORT 8-4487

• Challenging career opportunities available for engineers and scientists.

onset and aft cargo, pitch during VTO maneuver.

• Attended heavier and then, high mounted wings, with a span of 23 ft 6 in and no vertical tail.

To meet the streamlined D-155A platform as it rose vertically from a landing pad, a pilot probably would employ this type of release procedure:

Preliminary checklist complete, he would note the pilot's controls to verify position and then the four main leg engines to full afterburner power. He would then release the center landing gear, then the forward left leg, and position a "sugar scoop" thrust diverter in the all-around position at 1/4 Brumman's trim switch which "leads flight" in VTO mode.

Automatic action of the last moving thrust diverter is delayed and synchronized to the buildup of power in the forward engine pair. When this valve is allowed to "close", the thrust of all eight engines is throttled down.

Minimized side-slip near the pilot's left hand are two thruster banks. The four leading engines are controlled in the inward thrust; the four trailing engines to the outward.

With the inward thrust, the nose comes up and the full thrust of the leading engines is added to that of the wing tip governors. The D-155A breaks ground. Minimum power application results in an overall Brumman weight ratio of about 1.07 to 1 and a vertical rate of 3 to 4 ips.

At this point the pilot experiences almost no lag before Brumman nose over and engine response. He must however, maintain the inward thrust demands for thrust output of the typical fighter's nose sharply near 100% power.

### Transition Sequence

At an altitude determined by aircraft factors, the wind and wind conditions, the pilot initiates transition to level flight by incrementally lowering the aircraft's nose to gain forward flying speed. Simultaneously, he gradually rotates the nose down to maintain the spring-loaded switch on top of the leading engine thrusters.

Transition complete, the forward left engines are shut down, the forward & center repositioned to 22.5°, straight line flow of all engine exhaust and the reaction control system deactivated.

Simple feedback assemblies connect the reaction control system with the forward & center engines and the forward left engines to the D-155A. Even in low forward flight, small random area steering control surfaces on the plane's all-around control and forward stabilizers and its spanwise deflection vehicle carried out at place of elevation

length by spinning wing efficient still longer. Stick and rudder positions position the reaction control system through this linkage.

At emergence, shoulder control surfaces are deflected to maintain roll with a gross roll with nose horizontal and the thrust diverter valve open to obtain maximum accelerating open.

### Takeoff Technique

Run out prior to lift off is to take the missiles slightly and position the thrust diverter to direct aft cargo weight forward. This completes a 1/4 turn. Thrust components are readied to 100% to 105% of total power.

To maximize lift, full afterburner is employed with a tactical thrust vector control having a command having commanded by hand or digital switch. There, in turn, would be ranged by "autostart" command, undirectional reaction rates, all will be commanded. At an early afterburner D-155A would begin outward. Then



### French Test Dassault Etaf on Carrier

French Test Dassault Etaf is evaluated on the new French carrier Clemenceau. The strike fighter interceptors, powered by a SNECMA Atar 9C turbojet developing 9700 lb. thrust, aircraft gross weight is 35,900 lb. Hydrostatically operated leading edge flaps can be fixed at 25 deg or 30 deg position. The two nose radio location radar units one above the other, one being the transmitter unit and the other the receiving equipment. Dassault Vida radar is designed for over water operation. Radial control of in flight refueling is being developed.

CAPABILITIES FOR DEFENSE ...



# UNDERSEA -WARFARE-

Undersea Detection and Weapon Systems • Acoustic Guidance Systems • Propulsion Systems • Sonar • Navigation and Control Systems • Underwater Range and Oceanographic Research Equipment • Subsystems for Polaris Launching • Undersea Vehicles

The ocean depths—hidden, mysterious, unconquered: an arena where America's fighting strength must be superior. Westinghouse is helping to meet this challenge.



For example, one of the most important new ASW systems is ASTOR—fast, silent, deadly—a true underwater guided missile. This system, now in advanced development for the Navy, is one of many Westinghouse accomplishments for U. S. undersea strength. It typifies the advanced work that for nearly 20 years has characterized Westinghouse Electric Corporation's Ordnance Department at Baltimore. You can be sure... if it's

Westinghouse

Westinghouse



## Some ideas just won't wait

With over 70 advanced projects in the works, the Northrop atmosphere is so stimulating that ideas often refuse to wait—they compel attention wherever the inspiration strikes. Missile guidance, rendezvous and maneuverability in space, bioastronautics, universal checkout systems, laserlike fire control for aircraft, present instant, gratifying challenges. If you have sharp creative abilities in these areas, investigate the

intellectually engrossing engineering and rewards offered by Northrop's current and future programs. We seek exceptional engineers, physicists, and mathematicians to join our thinkers and doers. Send us a card today with your name, address, and area of special interest. *Aviation Week*, Inc., 1955, Box 1000, Glendale 1-2310.

**Northrop**

ang fuel nozzle or patternless wing tanks, the fighter would touch down at those selected sites ready to depart on a combat mission.

As the degree of D-188A dispersal is increased, the cost of operating the aircraft should drop, for fuel, armament and a modest amount of ground support equipment must be proportioned to the dispersal sites to ensure survival capability.

But notable capability Bell must retain, transforming the D-188A into a far more lethal—and, in the long run, eco-nomical—aircraft. Most of all, Bell, for example, could have a D-188A design and yet then incorporate and manufacture an aircraft that would be devoid of parasite weight and operated from a much base than could strike and penetrate objectives about 125 percent faster.

Only 3-4 dispersed targets could be hit for the same \$1 billion. But size and strike capability would be such that their effectiveness that these could destroy 375 potential targets, explains Bell.

Original D-188A design conceptualized for a disengaged integrated weapon system with a maximum speed of Mach 2.5 to fulfill the requirements of SOR 12. Under an agreement with Bell, the Canaan Division of General Dynamics was scheduled to be prime contractor (AWP Feb. 9, 1958, p. 25).

This partnership has, however, been broken, while Air Force design is supposed to target longer range STOL aircraft with a Mach 2.5 weapons system. In the place of new work is still to be the only two—*a* Mach 2 evaluation aircraft that would use the existing hardware and production regimen.

### Thrust/Weight Ratio

The D-188A's unusual pre-plant configuration dictates several key performance items in designing working within the constraints of an high performance VTOL aircraft. Of these, major thrust/weight ratios are materials in the aircraft's structure.

Today, advanced aircraft materials such as the 188 for the highest thrust/weight ratio are available to the industry, down to 1.0. Not until 1965, Bell predicts, will man-boosting, impact match ratios of 10 to 1. (Bell engine estimates clash as high as 15 to 1 during the first five years, but the thrust that they generate is not available due to VTOL constraints.)

He envisions a total thrust/weight ratio in the neighborhood of 17 to 1 in 1969 by a 70,000 lb. gross weight fighter-bomber carrying half its own weight in fuel. A significant lower ratio according to Bell, would down effectiveness from the weapons system by limiting its range and payload.

By placing all powerplants on the D-188A's extremities, Bell found that it could take full advantage of the site offered in the 188's about 2 or 3 to 1. Thus the fighter's center of gravity (CG)—where, pound for pound, load least weight balance is left again. The result is a load line bisected by the plane's CG and spacious enough to hold a spare 188.

Design also eliminates much of the weight during combat flight in a fighter's fighter mission, exposing overall thrust/weight ratio. Of equal or greater importance is the optimum endowments pressure pattern that forms when the D-188A operates in the VTOL flight regime.

### More Powerful 188-5

In giving the D-188's expected performance, Bell is banking on a series that more powerful version of the 188-5 than those that have come along to date. That such engines will be forthcoming is supported by General Electric's static limit, which indicates that substantial growth potential is inherent in the compact J57 powerplant.

For example, an afterburning J57 is rated at 13,010 lb. thrust aircraft, produced more than 3,000 lb. thrust during the development's qualification program. The output of the engine, at 7,500 lb. thrust, was boosted to 2,600 lb.

Total engine thrust output exceeds the maximum gross weight of a VTOL aircraft with available fuel, so by definition, the VTOL platform must break ground while experiencing forces less than 1.0. Work with the "Air Test Vehicle" and the X-14, two earlier VTOLs designed and flight tested by Bell, has convinced the company that conventional techniques are well suited for both vertical aircraft and for most supersonic missions imposed on a VTOL fighter-bomber.

To design new materials or improve existing for VTOLs mainly because such pre-plant offers a pre-plant specific fuel consumption of 1.0, is impossible. In addition, J57 engines, Jr. 401, and short burst impact has appeared. This according to O'Malley, is because the performance made possible in the newest new turbines' 10% better fuel economy can be matched by a 2.5% increase in the thrust output of standard turbines as a VTOL.

A third concern in this regard would enable a VTOL aircraft carrying 35% of its gross weight in usable fuel, at 11% of its weight in reserve fuel to exceed its existing value 10% without resort to radically changed pre-plant O'Malley maintains, adding "A 10% augmentation of fuel cell that provides approximately 40% more working fuel is most certain."

"For this reason," reports O'Malley, "we can supply you testing programs with model vehicles or tubes from which you can machine your prototype parts at the cost of the materials alone—no charge for testing. What better way to learn the costs of an existing new material for nozzle, exit cone, fin, nose cone, etc.? Please, write or write your requirements."

## NOW OPERATIONAL: Weather-sounding rockets carrying R/M Pyrotex® motor-tube liners



Motor-tube liners for core weather-sounding rockets are R/M Pyrotex asbestos-phenolic tubes. These have withstood a direct nuclear blast for periods up to 90 seconds.

High abrasion-resistance, good thermal insulation, high strength-weight ratio—all resulting from the unique R/M blend of phenolic resins and extra-long spacing-grade asbestos fibers—make choice of R/M Pyrotex materials ideal for this and many other high-temperature applications.

**Test R/M materials without testing costs.** We can supply you testing programs with model vehicles or tubes from which you can machine your prototype parts at the cost of the materials alone—no charge for testing. What better way to learn the costs of an existing new material for nozzle, exit cone, fin, nose cone, etc.? Please, write or write your requirements.



**RAYBESTOS-MANHATTAN, INC.**  
Reinforced Plastic Department, Division, Inc.  
2000 EAST 100TH STREET, CLEVELAND 16, OHIO  
TELEGRAMS: RAYMAN 1-2310  
TELETYPE: 44-1444



## 100,000 POUND FORCE MB VIBRATION EXCITER basic engineering completed...ready for customer order



The Model 10-10000 makes it possible to test complete assemblies — such as the aerospace Memory capsule, for example — at accelerations exceeding 30 g's! That's what environmental test engineers will soon be capable of doing with MB's new Model 10-10000 — the world's largest electrodynamic vibration exciter, now ready for production.

Capable of three amplitudes to 100,000 pounds, the massive new EL 10,000 has a range of 3 to 1000 cps full force and can be driven to 130 g acceleration. It stands approximately ten feet high, fourteen feet wide and will weigh an estimated 35 tons.

MB's new EL 10,000 exciter is another in a long list of firsts — still another reason why engineers everywhere recognize that the important advances in environmental testing come from MBs.

**MB ELECTRONICS**

A DIVISION OF TECTRONIC ELECTRONICS, INC., 1200 Main Street, New Haven, CT, U.S.A.

*The important advances in environmental testing come from MB*

"For the use of a short-term vibration test of about two hours, taking maximum advantage of the spiral bevel gear's temperature capability, the gear goes proven. One downside is a load preference, during the brief vibration from takeoff to forward flight, is through the use of temporary thrust augmentation devices such as water or gelignite to explain."

### Other Problems Solved

Although engineers still struggle with the increasing problem of engine and other VIGR applications, almost equally baffling a few years ago have been solved in Bell's. There's trouble about the temperature and the pressure patterns generated by an engine exhaust duct that is downward and the cause of dust of the airflow on landing pads.

After more than 1,200 test runs at a jet test stand, Bell concluded that common concrete had could withstand the 3400°F temperatures produced by the overheating 205 V's on the D-108A wing tips for long periods of sustained operation. Moreover, Bell found that concrete set in and when treated with one of several resinous poisons, could serve as a D-108A landing pad. If small abrasions can then place just large enough to shield the area of direct exhaust impingement were placed on the buried steel reinforcement, according to Bell's testing, avoided breakdowns of D-108A landing.

In considering the cause effects of the D-108A jet exhaust, Bell believes the speed with which the aircraft can become airborne is of paramount importance. Thus O'Malley explains:

The D-108A is capable of starting its engines and performing all preflight checks prior to its engagement except from the forward landing gear afterburning engine. As the engine are started, the aircraft is made for liftoff and will start into vertical ascent within two seconds of the nose afterburner power is applied. Total time for the aircraft to reach 10 ft. is about 1 sec.

With the same test rig, Bell conducted the temperature tests to reach in the very demanding D-108A test run up at full power, just prior to takeoff.

In general, it found that despite the 1000°F temperature of the wing tip exhaust, metal temperatures taken at ground level did not exceed 100°F. In fact, a 20°F undershoot.

Temperatures measured 30 ft. above the ground held below 100°F outside the aircraft. Thus Bell concluded that high velocities and high temperatures would not exist at the point where jet exhaust struck the ground under the aircraft.

## NOW... STOCK SPIRAL BEVEL GEARS TO CUT COSTS

Now for the first time Perkins offers a complete line of stock spiral bevel gears with precision quality to help you get maximum savings in tooling expense and gear cost. When you're planning for spiral bevel gears, design your requirements around the Perkins stock line. It can pay you well.



Perkins stock spiral bevel gears have salt bath and may be退火 to a maximum diameter. The gears are machined in pairs and lapped together after hardening for smooth running. In many cases these gears are available in left and right hand drives.

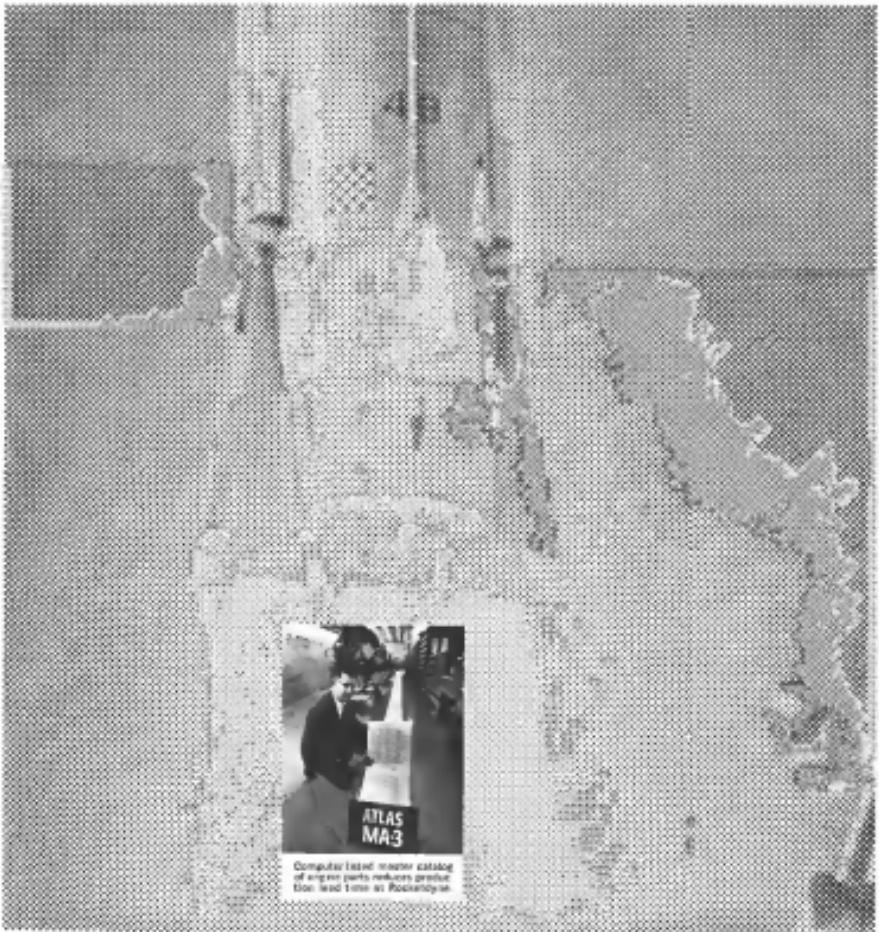
This new line of stock gears includes the most commonly used ratios and sizes proportioned according to the Gleason Spiral Bevel Gear Spur.



### AVAILABLE ON REQUEST

The new folder includes a detailed specification of Perkins complete line of stock spiral bevel gears. Write for folder No. 90.

**PERKINS**  
MACHINE AND GEAR CO.  
WEST SPRINGFIELD, MASS., U.S.A.



Computer based, master catalog  
of engine parts reduces product  
line lead time at Rocketdyne

# Keeping the cost of space down to earth

Behind the thundering performance of Rocketdyne's engines is a significant reduction in the cost of power for America's missiles. In fact, quality enhanced "Solid" Rocketdyne engineering skill and efficient production methods make it possible to power two missiles for the cost of one in 1987.

Rocketdyne, the pioneer in rocket science, was first with power for America's long range ballistic missiles—first with power for outer space. In establishing this technological leadership, Rocketdyne developed new management concepts at every level of operation: from early design through final testing. The result is outstanding technical achievement at the lowest possible cost.

In data processing alone, advanced techniques are saving Rocketdyne hundreds of hours of experimentation and testing and have contributed to a 31 percent reduction in Atlas engine costs for the Air Force. An intracompany communication network links test stands and research laboratories in Missouri, Texas and California, giving management the daily status of every program—whether it's on schedule, what parts are in short supply, how the production line is performing.

Through research, engineering, and management, Rocketdyne is constantly at work not only to enhance thrust performance and develop new propulsion techniques, but at the same time to reduce costs all along the line.

85 of America's 86 successful satellites and space probes have been launched by Rocketdyne engines.

FIRST WITH POWER FOR OUTER SPACE

**ROCKETDYNE**

DIVISION OF NORTH AMERICAN AVIATION

General Dynamics Aerospace Systems/McDonnell Douglas



## CEC makes them precise...



Type 4-112A Pressure Transducer



Type 4-113A Pressure Transducer



4-801 Direct-Acting Adapter

## Versatility makes them popular



4-800 Diaphragm-type Adapter

For adaptability in pressure measurement, there's no equal to the pair of unbonded strain-gage instruments pictured here. Not only can they be dash-mounted...;...diaphragm-mounted...;...water-cooled...;...water-proofed.

A workhorse with a thousand uses, Type 4-112A is available in absolute and gage models that measure pressures from 100 to 3000 psi in a temperature range of -100°F. to +200°F.—with superior performance in shock and vibration environments. The unit mates with a 4-800 chamber-type adapter as well as with an adapter for use in closed-line pressure measurement.

Type 4-113A, available in absolute, gage and differential models, is a general purpose transducer particularly suited to aerodynamic pressure studies. It operates in a range of 0 to 100 psi in gage, chamber and differential models and from 2.5 to >30 psi in differential mode. Used with a 4-803 adapter, it is ideal for closed-line applications.

Call or write for complete information. Ask for Bulletin CEC 1541-XA, Type 4-812A; Bulletin 480C 1549-23; Type 4-112A; Bulletin 480C 1550-23; Adapter-

Transducer Division

**CEC**

CONSOLIDATED ELECTRODYNAMICS / Pasadena, California

A SUBSIDIARY OF **Bell & Howell** • FULL PRODUCT DIVISIONS: MAGNAVOX

United Aircraft Corp. by the firm of Wärtsilä Flugzeugbau to build two German prototypes of the forthcoming version of the B-64 Flying Crane. If the two vehicles meet Go/no-go expectations, often probably will be built here under license for use by the air force as personnel transports and cargo carriers. Production also may later be extended to turn out 500s for Army and Navy use.

German officials have made studies of the B-64 poised for a two-hundred-unit installation of Pratt & Whitney JT4D-1A 15,000-lb. shafts and by two- and three-engine clusters of an advanced version of General Electric's T66 with 23,000-lb. shafts. Whether engine is chosen, the German government probably will purchase it directly from the producer, claim sources, thus saving for license rights.

### Missile Production

Although working within the NATO framework on production of missiles and components in the market use range—the air-to-air Sidewinder and the Hawk are already in production—West Germany now apparently has no plan to get involved with the development of larger vehicles of this sort.

Dr. Theodor Betzke, chief of West German air force research and development unit, said that, for the present, "we have no requirements of our own in this field. We are only following NATO recommendations. We do not go out and say 'we need these and they must be produced.'

Before and during World War II, Betzke adds, "the concern was great in the area but now the U.S. and United Kingdom are much advanced and we're following their lead."

The West German government, however, is establishing an Institute for Space Flight within the civilian German Research Institute at Meldheim, Baden. The institute, Betzke says, should be completed in one and a half years with a National Aeronautics and Space Administration liaison rather than with NASA itself.

After research is completed and other fields, including in collaboration with NASA, the institute will determine if it can handle "some special space technology" in the Western space program.

But that's not the end of West Germany's effort for space. In addition to aircraft and Dr. Betzke says the air force and industry have shown almost hand-to-hand in these progressive steps were both were resurrected in early 1958.

In the first step, former Luftwaffe pilots, returned by U.S. Air Force instructors, began flying aging U.S. equipment, notably the B-54 series. At the same time industry began



# Magnavox

AN/ARC-50 SYSTEM



Magnavox continues to maintain a position of leadership in the airborne communications field.

Magnavox engineering, in conjunction with the Air Force, has developed an advanced airborne communications system that is designed to meet the requirements of the future. Utilizing wide band techniques, such functions as television relay for bomb damage assessment, data link for control and identification, and many other forms of air-to-air and air-to-ground communications can all be realized over the same equipment as used for voice.



THE MAGNAVOX CO. • DEPT. 302 • Government and Industrial Division • POST WAYNE, IND.



# FOR HIGHER RELIABILITY IN THE HIGH TEMPERATURE RANGE

## MIDVAC STEELS MEET THE MOST CRITICAL DESIGN APPLICATIONS

Where parts for missiles, rockets, aircraft and other jet age products call for higher alloys of maximum reliability at temperatures of 1600°F and over, Midvac Steels offer designers new opportunities of applications.

Midvac Steels, produced by the consumable electrode vacuum arc melting process have these advantages over conventionally produced steels:

1. Improved input strength
2. Reduced input segregation
3. Improved chemical homogeneity
4. Refined cast structures—less forging reduction necessary
5. Improved densities
6. Gas content reduced to a minimum
7. Improved workability
8. Improvement in room temperature properties—toughness, impact, transverse ductility, etc.
9. Improvement in elevated temperature properties—no fatigue and stress rupture
10. Consistent higher quality produced—less customer headaches

Midvac Steels are offered in many alloys as billets or forgings. For special customer design specifications, complete strength and Micros. Steels, a comprehensive analysis of leading super alloys are available at new Midvac Steel Bulletin. Write for your copy today.

## MIDVALE-HEPPENSTALL COMPANY

Maplewood, Philadelphia 46, Pa.  
Subsidiary of Heppenstall Company, Pittsburgh, Pa.



Sebels—whom will build 110 aircraft with Messerschmitt responsible for final assembly and flight test. The Northern Group of Focke-Wulf, Hanseatic Flugzeug- und Werkeinsatz will build 100 Nordhafen aircraft in a plant shared with 33% ownership by BFW and the Technische Consult which, with BFW, will manufacture under license the General Electric J79 turbojet engine.

Approximately 250 aircraft are involved in the current production of the Fw 190. Dassier, which has final assembly and flight test responsibility, will build the center fuselage section, Messerschmitt the forward and rear fuselage sections, Breda the wing and tail assembly.

Klaster-Henschel, Dornier, of Ruhleben, Dornier, will build the G-91's Orpheus aircraft under license from Bristol Siddeley Engines, Ltd.

With special German requirements—including an engineless fuel system—incorporated into the basic design, the licensed model of the G-91 also has undergone its share of growing pains. Rollhoff, the first flight, however, was not conducted for another year, 1960.

As a major contributor to both the F-104 and G-91 programs and producer of over 60% of Germany's fighter planes at West Berlin, Messerschmitt can serve, perhaps, as an index of the German aerospace industry's revival.

Messerschmitt was in World War II with a staff of approximately 45,000, split among four main plants, including its headquarters at Augsburg.

For the year after the war, it began, starting during 1949 with the production of electrical sewage, insulation at its Augsburg plant, 75% of which was destroyed by Allied war raids during the war, and later following up with the manufacture of enclosed, three-wheel civilian tractors.

### Magnets, Rights

In its first reemergence, however, began in the summer of 1950 when the Germans agreed to come again to build the Fw 190a. Messerschmitt, Focke-Wulf and Miesesroth gained a major share of the production, as well as eventual contracts for the long T-33 trainer.

Forging, including forged and electroslag remelting, lead research and flight test of the Fw 190a was assigned to Messerschmitt. The completed fuselage, rot and assembled at a plant at Augsburg was then shipped to Messerschmitt's Munich Renn Airport for testing, with the wing, empennage and nose section fabricated by Ernst Heinkel Flugzeugbau. The Turbomeca Marboré power plants were supplied from France.

Beginning the operation with 1000 employees, Messerschmitt

achieved in G-91 and T-101 orders rolled in, his cash rebuilt its facilities and increased its employment in the present figure of 2,300.

The first 16 Fw 190s built are now on the assembly line, the Magister's first goes disappears from the line, the G-91's grace and the F-104's grace, and the fuel system is scheduled to be tested in Munich-Riem before the end of the year.

In all, the Messerschmitt-Bölkow-Blohm plant will have delivered a total of 112 Magister to the German air force since the first assembly roll-off of the production line in mid-1955—another 62 of the aircraft were delivered directly from Peter Altenrhein in the initial buildup stage.

### Three Nations

Behind the Fw 190 come the G-91 and the T-334 that will come from three different nations in four years, and, after that, possibly leading aircraft for Germany's own Messerschmitt-VTOL.

"I began speaking French," one production engineer says, "now I speak English to British. When we others are speaking English, I speak French."

One forward fuselage section, including cockpit, and one rear fuselage assembly of the G-91 already are entering their way along the final assembly line in Augsburg behind the last six Magisters and are scheduled to be delivered to Dassier within the next two months for testing with their other components.

When production is in full swing, the Dassier-Messerschmitt team hopes to turn out an average of seven G-91s per month.

First flight was not apparently not year ago and that first, Messerschmitt's test pilot has turned out over 2,000 flight hours for G-91 production. It still has another 900 to go. The first five rigs for the T-33 are also beginning to appear from the Augsburg plant, and the first flight of the G-91 has a target of about 2,500.

Messerschmitt will go to the future, still appears to be a question mark. Will it build up its own capacity so that it can handle entire subassemblies at an acceptable production rate, or will it build with one or more of its partners in the Southern Group—possibly Heinkel with which it is working on the VTOL. For the moment, at any rate, to have the answer. But, unfortunately, Messerschmitt is back on its feet, all roads ready to stand alone.

BMW offers a similar example in the engine field, although at present it is the underground leader.

First turning out Rapp 109s under license for the World War I conflict, BMW, The Reliant, a leader of the dazed automobile firms, had built to a force of 70,000 by 1944, producing, among other things, the

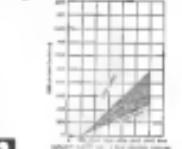


**3-LOBE DESIGN**  
Excluding the D-300 design  
with straight-rotor  
lobes, Messerschmitt  
rotary positive  
blowers develop  
greater pressures.

*Why M-D rotary positive blowers develop higher pressures . . .*

The unique combination of precision manufacture and modern design found only in M-D rotary positive blowers permits higher speed operation and higher pressures. For this reason M-D can furnish greater air flow at lower total cost.

M-D blowers operate at wider pressures and speeds than any other rotary positive. However, capacities of 22 production models range from 50 to 4,000 CFM, pressures to 14 PSIG weight, 70 PSIG motive stage.



A SUBSIDIARY OF HENRY DODGE PRODUCTS, INC.

## EXPANDING THE FRONTIERS OF SPACE TECHNOLOGY

### THE ASTROTUG



**Tughead for Space** Spaceborne scientific laboratories and platforms for further exploitation into space are an accepted concept based on established engineering techniques. Components would be fired as individual units into space, on precalculated orbits, and there assembled. To solve the major problem of how men are to live and work in space during the assembly process, Lockheed has prepared a detailed engineering design of an astrotug—a manned vehicle housing a crew of two or three. Module-furnished, the astrotug will be capable of supporting its crew for a number of days in an environment of suitable atmosphere and with provisions for illumination and adequate food and water.

The Lockheed astrotug is a completely independent working vehicle. Personnel need not leave it in space stay in order to work on the project of assembling the space station components. As shown in the diagram, the big engine of two double-walled pressure vessels approximately 20 feet long overall and 9 feet in inside diameter. Six rolling mid-size wheels are arranged for maneuvering. On the forward end, extending from the mechanical manipulator arms with interchangeable hands for such specialized functions as grapping, welding, maneuvering, cutting, running screws and bolts, hands can be changed by remote control from inside. Viewing ports provide uninterrupted observation. Radar, antennae, searchlights, and other equipment necessary to the tug's work are mounted externally. Main controls and instruments including radar, radio, infrared, computers and navigation consoles are duplicated in each of the two major compartments as a safety measure.

Men working in single units aboard in space units would have little applicable free and could work for very limited periods of time. With the Lockheed astrotug, personnel could carry on the work in relative safety and comfort with maximum efficiency. A special recovery vehicle separate from the astrotug has been conceived for ferrying to and from each. Tugs themselves would remain floating in orbit indefinitely, being regenerated and refurbished as fresh crews arrive in relief.

Space vehicle development is typical of Lockheed Missiles and Space Division's broad diversification. The Division possesses complete capability in more than 40 areas of science and technology—from concept to operation. Its programs provide a fascinating challenge to creative engineers and scientists. They include: celestial mechanics, computer research and development, electromagnetic wave propagation and radiation, electronics, the flight sciences, human engineering, magnetohydrodynamics, man in space, materials and processes, applied mathematics, astrophysics, operations research and analysis, atomic, nuclear and plasma propulsion and fusion fuels, space-space communications, space medicine, space navigation, and space physics.

**Engineers and Scientists:** Such programs reach far into the future and deal with unknown and stimulating environments. It is a rewarding future with a company that has an outstanding record of progress and achievement. If you are experienced in any of the above areas, or in related work, we invite your inquiry. Please write Research and Development Staff, Dept. L-17, 982 W. El Camino Real, Sunnyvale, California, U.S. citizenship or ensuing Department of Defense individual security clearance required.

## **Lockheed** MISSILES AND SPACE DIVISION

*Systems Manager for the Navy's POLARIS FBM, the Air Force AGENA Satellite in the ORION/VERNE, MIDAS and SAMOS Programs*

GENERAL FIELD ALBION, NEW YORK; SANTA MONICA, CALIFORNIA; SANTA BARBARA, CALIFORNIA  
CAPE CANAVERAL, FLORIDA • PARIS

**DELTA**  
AIRLINES

Delta's first Convair 880 set a commercial plane speed record by averaging 667.37 mph en route to coast-to-coast delivery. Right: Glass monoplane. Left and above: white twin marks the sleek 94-passenger jetliner. Electronic tube complement? G-E 5-Star Tubes is critical market of all Delta 880's.



Says **L.G. ROSEFELD**, Superintendent of Communications, Delta Air Lines

## "YOU'LL FIND G-E 5-STAR TUBES LIKE THESE IN EVERY NEW, FAST DELTA 880 JET!"

"Part of Delta's pattern of progress, is to feature equipment and components which has proved exceptionally reliable. On electronic tubes, we keep life records going back many years. We know tube performance. Our extensive 'book' on tubes is the reason why Delta's new Convair 880 jets have General Electric 5-Star Tubes installed in wind navigation and communication sockets.

"The same with Delta's D-68 jetliners and plasma-powered planes. Our radar monopodes, for example, are virtually 100% equipped with

5-Star Tubes. Their high tube reliability is a major contribution to flying safety.

"Count us as convinced, after many years' experience, that General Electric 5-Star Tubes are a superior product you can rely on!"

\* \* \*

Your nearby General Electric tube distributor has 5-Star Tubes in stock—gives fast delivery service. Telephone him today! Distributor Sales, Electronic Components Division, General Electric Company, Louisville, Kentucky.

*Progress Is Our Most Important Product*

**GENERAL**  **ELECTRIC**

Model 109 093 turbjet engine for the Messerschmitt 232.

Of the seven giants they maintained during World War II, their long-renowned precision of one located at a remote section of the Munich suburb of Moosach-Alth.

In 1950 began building, in 1954 when BMW established a study group to see what could be done and in which direction. In 1955, with 150 complete BMW 5000 engines ready for the limited production of 250 by 1956, training GOM/BM 246 piston engines for Germany to Germany for the STIG. The 27-cwt plane and its engine, the Gomco, was the first aircraft to fly with a German-made engine.

149 hours, the first under license, the same time it took to repair all of all capsules it could find.

Tubes with over 1,000 examples, BMW is preparing to build components for the F-104 in collaboration with Belgian and Italian partners and is laying plans for assembly and eventual all engines scheduled for the F-104G of the German air force. It is still building and evaluating the Licensor and has an overhauled contract from the West German air force for the manufacture of Continental 10 and Mark 11 tank carriers.

In addition, in May BMW began to gain new test experience in evaluating the Daimler engines for Germany in

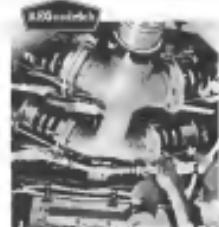
form. Set up in both at Cologne. So far, air flow, and BPPW, gear experience with the engine, it is now sold as for overhaul after over 300 hr, in opposed to the 400 hr figure for the Royal Canadian Air Force. An experience is gained because the figure probably will be gradually increased to 400 hr.

BMW executives say, there is much work, in the design and production of small turbine engines, plus the continuing increased problem of large powerplants such as the F-104 to gain the necessary data before embarking upon their own.

### New Turbines

Their development group already has designed a multi-purpose turboshaft engine where long-range is being boosted from the 80 of two years ago to 180. Versions of the engine already are being tested on a parallel order considerably by Algiers in Germany, and others are being offered for with passes or heat exchangers to return Army liquid tank pipe line passes and powerplants for ship surface drives.

Within the next year or so, BMW hopes to take a further step with the introduction of a family of 300 to 500 lb thrust turbines for small aircraft aircraft. From these, all the types and forms of the various turbine engines will multiply.



### FLEXIBLE RUBBER COUPLINGS PROTECT FUEL LINES

Another type of lightweight coupling for aircraft fuel lines has the flexibility to withstand bending and tension that could cause failure in rigid lines. In addition, the couplings are significantly lighter than the metal type. For free literature write

**B.E.Goodrich**  
aviation products

Dept. AWP 110, Akron, Ohio

### PRODUCTION BRIEFING

General Electric's Aircraft Division, Turbine Department, Lynn, Mass., has received a study contract from Lockheed on the use of a lightweight gas servo system for flight vector control of aircraft.

General Electric's Small Aircraft Engine Department, Lynn, Mass., has received an order for 14 CT15-100-2 gas turbine engines from Vought Division, Boeing Airplane Co. Engines used in approach to V-1 will be used to be delivered starting in mid-1961 and are to be installed in Vought's 107 aircraft beginning.

Twin Coach Co., Buffalo, N. Y., has received a \$664,000 order from Raytheon by aircraft canister for the fixed-wing aircraft system.

NASA has awarded a \$100,000 contract to General Electric's Defense System Department, Syracuse, N. Y., for radar display and computer equipment. The equipment, to be incorporated into a system called Terminal Guidance and Data Processor, will be installed at NASA's Flight Research Center, Edwards AFB, Calif., for use during tests of the North American X-15.

### PROBLEMATICAL RECREATIONS 43



A model 15 inches long will turn 9 holes. 1 inch at the hour and will be consumed in 20 minutes. less than the same length at the top end. How long will it take for an inch at the hour end to be consumed?

—Lester Davis, NYA

Our 8000 model Bi-pivot, used in cockpit electronics, incorporates a high-gain, low-noise amplifier and a compact FM transmitter, yet fits in the palm of your hand. Delivery can be made in 45 days. For complete information write to Computer Systems Laboratory, Litton Systems, Inc., 5390 Cimarron Ave., Woodland Hills, California. ANSWER TO LAST WEEK'S PROBLEM: Green Stockout come in whole numbers—st. count 16 to the Walla.

**LITTON INDUSTRIES**  
Beverly Hills, California

Have a  
Metal Cleaning  
Problem



## Detrex Engineers Have Been Coming Up With "Cost Saving" Answers for 30 Years

Every metal cleaning operation has its own particular problems—but they're seldom new to the Detrex engineer. With 30 years of experience, he can produce the right formula to insure maximum productivity and economy in your operation.

He will analyze your product, the type of soil to be removed, the proper equipment and cleaning agent needed, the space and manpower required—every factor that bears on the problem.

When he gives you his recommendation, you can depend upon it to make sense—and save dollars. And when you put his recommendation into practice, you can depend upon Detrex to follow through with the finest service in the business.

DETREX INC.  
Every Metal Cleaning  
Problem Solved  
• 21,000 A. 12,000 B.  
• 15,000 C. 10,000 D.  
• 10,000 E. 10,000 F.  
• 10,000 G. 10,000 H.  
• 10,000 I. 10,000 J.  
• 10,000 K. 10,000 L.  
• 10,000 M. 10,000 N.  
• 10,000 O. 10,000 P.  
• 10,000 Q. 10,000 R.  
• 10,000 S. 10,000 T.  
• 10,000 U. 10,000 V.  
• 10,000 W. 10,000 X.  
• 10,000 Y. 10,000 Z.



**DETREX**

CHEMICAL INDUSTRIES, INC.  
Box 501, Dept. AW 1260, Detroit 32, Michigan

World's Largest Exclusive Producer of Cleaning Chemicals and Equipment



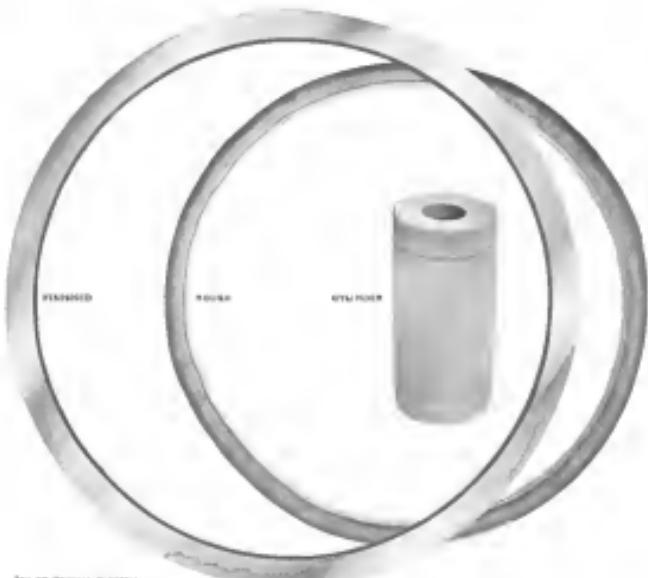
Grumman W2F Hawkeye is aided by its anti-takeoff which extends 18 ft. above the ground when in flight position.

## Grumman W2F-1 Hawkeye Design Details Shown



Main gear of the W2F retracts forward and retracts to engage the snubbers of the Allison T56 turboprop engine. Note snubbers and gear strengthened to withstand stresses caused by the main wheel outboard launcher.

NOW—A WELD-FREE RENÉ 41® RING DEVELOPED BY C-M TO ELIMINATE THE PROBLEMS OF WELDED RINGS. C-M'S RENÉ 41 RING IS FORGED FROM A CYLINDRICAL CASTING INSTEAD OF ROLLED FROM BAR STOCK AND WELDED. THIS INTEGRAL, WELD-FREE RENÉ 41 RING IS THE RESULT OF A CASTING PROCESS DEVELOPED BY C-M USING A THIN CROSS SECTION RATHER THAN THE CONVENTIONAL THICK INGOT. BECAUSE THE CROSS-SECTION IS THINNER, IT COOLS FASTER. THIS FASTER COOLING PREVENTS SEGREGATION OF ELEMENTS—ELIMINATES STRONGER GRAIN SIZE IN MORE UNIFORM FOG, AND THE RING HAS GREATER HOMOGENEITY THAN RINGS PRODUCED BY OTHER METHODS.



TM OF GENERAL ELECTRIC

C-M'S PROCESS CAN HELP SOLVE YOUR RING PROBLEMS IN RENÉ 41 AND OTHER DIFFICULT-

TO-FORGE IRON, NICKEL AND COBALT ALLOYS. WRITE TODAY FOR COMPLETE INFORMATION.



**CANNON-MUSKEGON CORPORATION**

METALLURGICAL SPECIALISTS • 2311 LINCOLN STREET • MUSKEGON, MICHIGAN

## WHAT'S NEW

### Reports Available:

Following reports were sponsored by the Office of Technical Services, U. S. Department of Commerce, Washington, D. C.

**Sonic Military Detonation**—199 page translation in the U. S. Area of basic operational, tactical and general military terms. \$4.00 (88-21750).

**Photogrammetry**—Bibliography. Lists technical research reports, translations of foreign literature and government issued patents available for license. \$1.00 (88-480).

**Photographic Chemicals and Emulsions**—Research reports, foreign technical literature, etc. Listed in Bibliography \$1.00 (88-487). List of 200 OTS value line bibliographies can be obtained on request without charge from OTS.

**Physical and Mechanical Properties of the Cobalt-Chromium-Tungsten Alloys**—Welding, Metal Information Center or Battelle Memorial Institute \$5.50, 21 pp. (98-162316).

**New International Flight Information Manual** Issued by Federal Aviation Agency—\$5.50 from Superintendent of Documents, U. S. Government Printing Office, Washington, D. C.

**Cooling Methods and Equipment for Supersonic Aircraft**—C. R. Werth and others, Douglas Aircraft Company, Inc., for WADD, U. S. Air Force. 1960 \$5.00, 119 pp. (88-161731).

**Instrumentation Package for High-Performance Studies**—M. N. Goldberg and others, North American Aviation, Inc., for WADD, U. S. Air Force. Feb. 1960 \$2.00, 71 pp. (88-161712).

**Synthesis of New High Temperature Materials**—J. L. Hagle and others, Standard Research Institute, Inc., for WADD, U. S. Air Force. Feb. 1960 \$1.50, 44 pp. (88-161720).

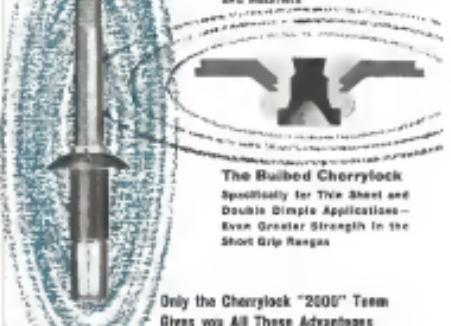
**Friction and Wear at Elevated Temperatures**—Z. Robozova, Massachusetts Institute of Technology, for WADD, U. S. Air Force. Jan. 1960 5.75, 21 pp. (88-161719).

**Protective Coatings for Refractory Metals**—C. G. Bergman and others, University of Illinois for WADD, U. S. Air Force. Jan. 1960 \$1.25, 50 pp. (88-161739).

**Comparative Properties of Heavy High-Temperature Alloys**—A. S. Nowicki, State Co., 270 Park Avenue, New York, N.Y.

## THE CHERRYLOCK TEAM

**The Standard Cherrylock**  
Top Performance Through the entire range of Dimensions, Grips, and Materials.



**The Bulbed Cherrylock**  
Specifically for Thin Sheet and Double Dimple Applications—Even Greater Strength in the Short Grip Range.

Only the Cherrylock "2000" Team  
Gives you All These Advantages

- Mechanical Locking System
- Quick, Precise
- (No Sheet Thinning)
- Positive Clamp-up
- Full Grip Range
- Complete Hole Fill
- Positive Visual Inspection
- (Grip Marked on Head)

A-260 Stainless Steel—Monel—Aluminum

The Cherrylock "2000" series team offers the first, most adaptable aircraft rivet yet developed. Maximum part strength and reliability are obtained by using the Standard Cherrylock to cover the entire range of applications. The Bulbed Cherrylock for sheet grips and double dimples, the Standard Cherrylock in the long grips. Both types are installed with the same 8-080 series pulling head, using existing Cherry grip.

Higher joint strength allowable, due blind side clearance, and the "Positive" grip.

widest grip ranges available—only with the Cherrylock Team—yield a better fastener at lower cost. The Cherrylock Team provides the strongest mechanical lock—fast fractures when available. Positive visual inspection after installation—with grip length marked as the next head—is offered only by the Cherrylock Team.

For technical data on the Cherrylock Team of rivets, write Cherry Rivet Division, Townsend Company, Box 2357-N, Santa Ana, Calif.

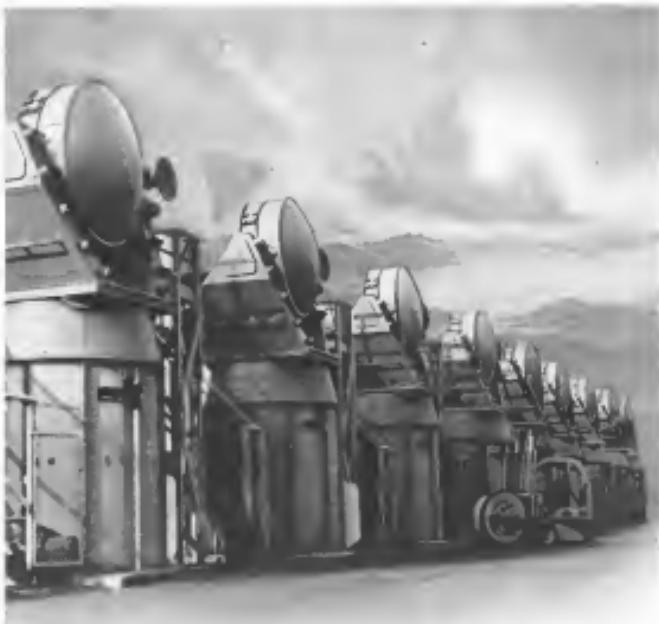
## CHERRY RIVET DIVISION

SANTA ANA, CALIFORNIA

**Townsend Company**

ESTABLISHED 1876 • BEAVER FALLS, PA.

In Canada: Townsend & Acheson Manufacturing Company, London, Ontario, Ontario



## TERRIER RADAR: For First-Class Missile Marksmanship

The Navy's deadly surface-to-air Terrier missile, in both its original and its advanced versions, Sperry provides the means of expert marksmanship at sea—the SPG-55 Missile Guidance Radar.

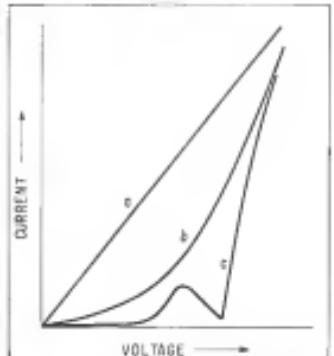
Developed jointly with the Bureau of Naval Weapons, Sperry engineers designed the fast production to meet delivery dates... yet controlled the critical quality of these complex high-performance shipboard radars. New units are shown "on the line" above, undergoing final checkout prior to shipment.

The SPG-55 is in duty with the Navy's newest guided missile destroyers, carriers and carriers, including nuclear class surface ships. Able automatically to acquire, track and guide the Terrier missile to intercept, the SPG-55 is part of a fast control complex that incorporates... as well as... precision guidance—the most advanced evaluation and computation systems, all produced to highest reliability standards, and on accelerated schedules, by Sperry.

**SPERRY**

SURFACE ARMAMENT DIVISION, SPERRY-HYDROSCOPE COMPANY—DIVISION OF SPERRY RAND CORPORATION, GREAT BRICKLEY, PA.

## AVIONICS



HOW SCHOTTKY diode using Schottky diode principle may be the forerunner of an entirely new family of devices. Experimental diode shown at left consists of two metal films separated by a thin dielectric deposited on a glass substrate. General Electric researchers also found that if metal contacts deposited on a glass substrate are oxidized and annealed by using superconductive metal films, then after subjecting the metal to temperatures may lead to an entirely new family of electronic devices.

## Tunnel Effect Found in Thin Metal Films

By Philip J. Klass

New York—Dramatic by General Electric that the tunnel effect found in semiconductors also occurs in certain combinations of thin metal and insulator films when subjected to near-threshold temperatures may lead to an entirely new family of electronic devices.

Precise knowledge of the new phenomenon suggests that a single thin device, produced inexpensively in disposition of thin metal films of near-micron dimensions could provide a variety of circuit functions as in conventional electronic forms "in a package."

If subsequent costly proofs prevent optimism the new technique might first work in great as major on electronic technology. The need to separate the devices... and divide into two parts may limit their use somewhat. GE emphasizes that such devices can not pass around the corner, except for research needs.

Obviously when two metal plates are

separated by an insulating material, as in a capacitor, no current will flow between the plates when a dc voltage is applied across them. This holds true unless the insulating breakdown is at small as 0.0001 in. (100 picometers).

However, if the insulating thickness is reduced to about one twentieth of a micrometer, current will flow as a result of what is called the tunneling effect. The magnitude of the current is proportional to the applied voltage, as in conventional electronic forms "in a package."

If these metal films, fabricated from

two different superconductive materials are used in the p-n junction and subjected to an off-threshold temperature, the negative resistance region where current increases with increasing applied voltage begins.

The foregoing suggests that a single device can exhibit three different types of characteristics—depending upon whether both of its metal films are superconductive, one superconductive but in an opposite state, because a magnetic field can be applied over the junction, or when one or both of the metal films become superconductive.

In a Bureau of Naval Research laboratory, found that when one metal film is itself in superconductivity, but the other is not, the amount of negative resistance current is greatly reduced. If low applied voltage, but builds up rapidly as voltage is increased from "0."

When temperature is dropped by

Engineer inspects Styroflex® cable installed  
in an antenna array at one of Pacific Scatter  
Communication System stations shown at right.



## Over 40 miles of *Styroflex® Coaxial Cable* help assure

More than 200,000 feet of Styroflex® coaxial cables are in active use in balanced antenna feed lines in the recently completed Pacific Scatter Communication System stretching from the Hawaiian Islands to Okinawa. This trans-Pacific system, one of the largest and most advanced of its kind in the world, uses ionospheric and tropospheric propagation techniques that produce over 99% reliability. An important part of the Strategic Army Communications Network (STACOM), the system was designed, developed and constructed by Page Communications Engineers, Inc. for the U. S. Army Signal Corps.

Each of the nine stations in the network is equipped with the same major component parts—transmitter, exciter, multiple terminals and antenna. The cables used in the 200- and 400-foot antenna arrays range from 3/4" jacketed Styroflex® cable to 3 1/2" jacketed Styroflex® cable. About 7,000 feet of 3/4" jacketed Fourflex® cable is also used in the system. The Styroflex® cables were spliced in the field by an inter-gas flame welding process to assure noise-free connections required for successful diplexed antenna operation.

The extremely low inherent noise level and low attenuation of Styroflex®—together with this air-



## Pacific Scatter Communication System reliability!

dielectric cable's stable electrical and mechanical properties—especially qualify it for the critical specifications of this STACOM system. If your system requires

ments call for a cable with low loss and high reliability, investigate the successful record of Styroflex®.

(Photo courtesy of Page Communications Engineers, Inc.)

### PHELPS DODGE COPPER PRODUCTS

CORPORATION  
600 Park Avenue, New York 22, N.Y.





**VOLTAGE** applied to a thin-film experimental device is adjusted by Dr. John Giese, of GE Research Laboratory. In background is monitor on which current/voltage curve was recorded.

varying the temperature of the metal filaments and/or subjecting them to a magnetic field, Giese points out.

Because the current-voltage characteristics are greatly different from those of insulation or vacuum tubes, the new device will expand the development of new circuitry related to the new device.

The name was that of insulation with respect to vacuum tube circuits.

General Electric has conducted experiments using films of aluminum, lead, indium and tin, all of which have been deposited at temperatures near those of liquid helium. A stable number of other metals are expected to exhibit the same effect.

Aluminum made up most of the insulation in most of the experiments, but GE tests indicate that tantalum, titanium, molybdenum and nickel oxide

will also exhibit the same effect.

Because the new device is a solid-state

device, it can be made in a single

chip circuit configuration on a single

substrate of insulation by means of well-

known vapor deposition techniques.

This suggests that both the size and cost of certain types of equipment, such as digital computers, might be greatly reduced through use of the new high

speed circuitry.

The small fraction of electrons that pass through is said to "tunnel" through. The greater the insulator, the larger the fraction of tunnel electrons (current) that pass through.

The fact that certain metals at extremely low temperatures become superconductors (lossless electrical conduction), and tend to resist penetration by magnetic fields providing the latter do not exceed a critical strength, has been known for some time.

Another, less well-known property is that metals in a superconducting state will reflect electrons waves whose energy levels lie in a narrow range called the "energy gap."

The metals that can electrons in the wave form which have energies equal to the "forbidden" energy levels in the other metal film will not be able to tunnel through the intervening conductor. The particles forbidden energy gaps that exist in the metals used have a significant effect on the tunneling currents that can pass through the insulator. It was this effect that Giese discovered in the course of his experiments.

If superconductivity is destroyed by raising the temperature or by application of a sufficiently strong magnetic field, the forbidden energy gap disappears and tunneling currents can start flowing. If the electron waves can be given increased energy by applying a higher voltage across the plates, it is possible to prevent tunneling currents from flowing, according to Dr. John C. Fisher of GE's Research Laboratory.

Dr. Giese feels GE can produce and design a number of circuits, with the new finding "as important as the discovery of the transistor" which is "so much that all of its consequences can not be fully determined."

#### Tunneling Theory

The theory of tunneling and its application to the phenomenon is found in semiconductors but not given adequate theory to explain the phenomenon in metals. GE says. Not so the basic mechanism responsible for superconductivity fully understood. It is, these three, not surprising that scientists have had difficulty in explaining the effects produced by the combination of the two.

Present knowledge indicates that the tunneling effect is best explained by considering electrons as waves rather than particles. These electrons waves travel through metals (conduction), but



**Prying saucer!**

**AERONCA** designs and produces precision antenna systems for advanced radar complexes

Introducing new concepts in design and construction, Aeronca precision antennas set new standards in precision . . . regardless of size. The principles and accuracy inherent in the 80 foot X Band dish (illustrated above) are adaptable to antenna designs of virtually any size or shape.

Aeronca antennas are lightweight high-strength metal structures of honeycomb sandwich construction. Developed by integrated design-tool-process capabilities, they are fabricated by advanced techniques that substantially reduce tooling requirements . . . simplify unit design . . . assure low cost producibility. In addition, Aeronca antennas permit lighter support structures and mechanisms because they weigh 45% to 60% less than conventional designs.

Whatever your antenna problems, Aeronca can supply "readymade" replications to meet your requirements and specifications. For details, write for BULLETIN A-400.

**AERONCA** manufacturing corporation  
1014 Germantown Road  
Middletown, Ohio

Operating the largest R&D Engineers with Micro-Space experience. Write to D. E. Chidester, Mgr. Product/Design Department.



**ATTACH AERONCA SYSTEM** to almost complete range of antenna for electronic data processing centers.



**ATTACH AERONCA SYSTEM** to electronic data processing centers.

## C-W Optical Maser Studied for Space

Dayton, Ohio—Supported by grants employing a continuous-wave optical maser will be the goal of an unusual project now under way at UC's X-11 lab. The effect to establish the applicability of currently developed optical maser to space communications.

A contract awarded to lead to the development of an experimental optical maser transmitter along with an appropriate antenna is an integral part of the



PHOTOGRAPH BY ANTHONY C. COOPER

*Martin-built Pershing—a major breakthrough for the Army in its program to develop the modern missile as a mobile field artillery weapon. Pershing moves over the roughest terrain on its own mobile launcher, is ready to fire within minutes.*

**MARTIN**  
ORLANDO



## IMPORTANT NEW OPENINGS FOR CREATIVE ENGINEERS

The Martin Company, at Orlando, Florida—prime contractor for Pershing, Bullock, Lacrosse, Missile Master and BIRDIE—has senior level openings on its Technical and Research Staff in the following high-priority:

- Operations Research—working software definition and prediction methods for existing and proposed weapon systems
- Information Theory—with emphasis on optimum coding and signaling techniques
- Digital Computers—analysis and advanced research, including learning machines
- Electronic Spacetime—conceptual evaluation of advanced weapon systems
- Inertial Guidance—conceptual and analytic investigation of advanced systems using novel components
- Electronic Packaging—utilizing thin films and micro electronic technology
- Environments—study of shock, vibration, acoustics, temperature, and natural environments
- Structures—development of new concepts, materials, apparatus, and design criteria
- Human Factors—analysis related to military and space applications
- Missile Propulsion—liquid and solid rocket propulsion and air breathing systems
- Ground Support Equipment—with emphasis on mobile missile systems

If you are qualified for senior level work in this highly select staff, please send a brief resume to Mr. C. H. Lang, Director of Employment, The Martin Company, Orlando 22, Florida.

HOME IS THE CLIMATE OF ACHIEVEMENT

**MARTIN**  
ORLANDO

AERONAUTICS WEEK, December 8, 1960

communications system will be needed in the Air Force in mid-December, informed sources have indicated.

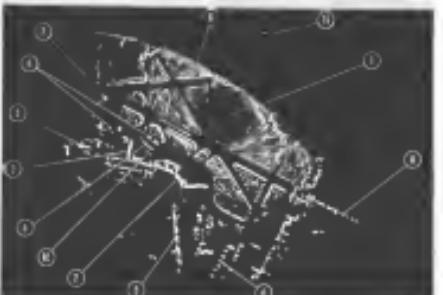
Eight companies attending a recent bidding meeting held at Wright Air Development Division, lead Air Force contractor, in its requirements for the space communications system. The eight are: Bell Telephone Laboratories, Electro-Optical Systems, General Electric, General Precision Laboratories of General Precision, Inc., Hughes Research Laboratories, ITT Laboratories, Rutherford and Technical Research Group.

Although technical people from six out of the eight companies previously proposed details on the feasibility of meeting USAF requirements for the optical communications system, four firms present at the bidding are believed to

have subsequently submitted system proposals.

Essentially, the Air Force desires a transmitter in which an optical source will be both a source of continuous wave radiation and an amplifier. Power for the source is to be supplied by the sun's energy and will be collected and concentrated by a lightweight mirror (a folded solar collector system of the type proposed to WADC under a separate solar communications system contract (AW May 2, p. 161) by Electro-Optical Systems.

Optical masers operated by Electro and Bell Telephone Laboratories (AW Oct 24, p. 75) couple high index of power sources and provide pulsed output. Ruggedized radiation power density for the USAF-designed device along with its sensitivity is to be greater than



**Taxi Radar Outlines Washington National**

This radio view of Washington National Airport, as seen by newly installed Airport Radar Detection Radar, the heart of 100-wheelchair automobiles at major airports, shows an extremely high resolution of the equipment produced by Aerotron Instruments Laboratory. Radar scope photo below (left) view of Washington airport shows (1) control tower, (2) main terminal buildings, (3) south terminal building, (4) control tower, (5) tracks of aircraft being in parking rings, (6) lights, (7) lights, (8) tracks of moving field truck and (10) navigation strip in Potomac. Radar was developed for Federal Aviation Agency and Air Force.

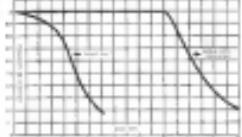


## WHAT AN IMPROVEMENT IN RADAR PERFORMANCE!

This new Video Correlator is now available as a plug-in unit for fire control and search radars both airborne and ground-based. Flight and laboratory tests have proved that this compact, 0.3 cubic foot radar augmentation device • makes target detection certain • serves as an effective counter-countermeasure • reduces interference from other radars • eliminates external and self generated radar noise. Vought Electronics designed the unit for easy back fitting into existing systems. It contains its own power supply and requires only a simple rigid mounting somewhere in the aircraft.



HERE IS HOW VOUGHT ELECTRONICS VIDEO CORRELATOR INCREASES THE PROBABILITY OF DETECTION WITH ONE EXISTING FIRE CONTROL RADAR.



FOR FURTHER DETAILS ON ANY ONE OF THE MANY APPLICATIONS OF THIS RADAR ENHANCEMENT DEVICE, WRITE:

CHANCE VOUGHT ELECTRONICS DIVISION  
MILITARY, TEXAS

ANTENNAS • AUTOMATIC CONTROLS • NAVIGATIONAL ELECTRONICS  
• GROUND SUPPORT ELECTRONICS

that obtainable by direct reflection of sunlight energy.

Should the sun-powered transmitter power transmitter, it will need to withstand the effects of thermal and electrical power sources (AMW Dec. 16, p. 87) who have located the device in several different climates for space communications and radar. For such purposes, the point out, optical power sources would be high directional, passive, capable of transmission over remote distances, and possibly require little power. Use of the sun as a power source, in terms of pump power, would substantially simplify and lessen the weight of the device.

Neither the output bandwidth nor the output frequency was specified in the USAM report. Input or pump frequency will be in the solar spectrum (which includes infrared, ultraviolet and visible wavelengths), probably in the visible and far-infrared range of the optical spectrum above 1000 Å. The pump will be a narrow line source, since the pump will not produce more power than the optical source.

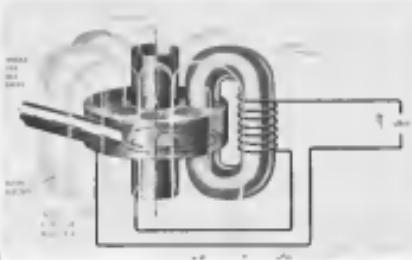
Some of the firms at the industry's leading, including Bell Laboratories, Hughes and TRW Research Group, are known to be looking at a variety of materials which could extend optical laser operation into infrared or ultraviolet regions. But it is not known whether the pump source spectral requirements for these materials are still in the solar spectrum.

The USAM sun-powered transmission program will be divided into two phases. There are:

- Phase I—Study and investigation to determine proper approach and correct techniques needed for the sun-powered optical power transmitter.
- Phase II—Design, fabrication and testing of the transmitter.

What combination of the various control optical circuit will be of concern in modulating techniques will not be stressed in the program. Output power density of the transmitter will be 10 Watts per square meter when using a collector mirror of one square meter.

Present Air Force funding of optical power development consists of a \$1-million dollars-on-contract from the Air Force Office of Scientific Research with Technical Research Group, Smith, N. Y., a \$70,000 WADD contract (AMW July 18, p. 90) with Hughes Research Laboratories, Malibu, Calif., and a very small effort at Colorado University in Boulder. In addition, Electro-Optical Systems, Pasadena, Calif., is nearing completion of a one million dollar program for the development of a soft communications system using light as the information-modulated carrier. AMW Jan. 1 (p. 15) and General Precision Laboratories holds a \$75,000 Ruse Air Development Center award (AMW Mar. 14, p. 76) for investigation of nonresonant techniques in wave



## Magnetohydrodynamic Power Generator Developed

Small magnetohydrodynamic power generators developed by Thompson Ramo Wooldridge will be further investigated under a new contract awarded the company by National Aeronautics and Space Administration. Designed to operate over a wide range of power levels from a few kilowatts up, the device is called a variable magnetohydrodynamic power generator. Possible applications for the unit, as formerly by the company, include use in a manned space vehicle as a source of emergency power, as an intermediate storage form to the world's power source, and as a source of short repetitive bursts of extremely high power output. As in earlier magnetohydrodynamic power generators such as the one developed by General Electric's Aerospace Laboratories last year, the Thompson Ramo Wooldridge unit depends upon the movement of a hot plasma across a magnetic field to induce an electrostatic force between two electrodes. In effect, the hot plasma carries the number and location of a current between the electrodes. Unlike the earlier General Electric device, the Thompson Ramo Wooldridge unit MHD power generator is designed so that the hot plasma will become spaced prior to the magnetic field. This varies the pattern of the gas, according to TRW, significantly improves the efficiency of the magnetic field, increasing the power output/weight ratio of the generator.







MISSILE  
LAUNCHER  
MADE  
MOBILE-LIGHT,  
TAKEOFF-TOUGH  
WITH

# N-A-XTRA

HIGH-STRENGTH STEEL

A battlefield might be anywhere. Wherever it is, there may be need to fire over 10,000-pound, 35-foot Scud-type missiles. Use American Steel products. That's why the launching station on which the missile is mounted, aimed and fired must be light enough to be transported by land, sea or air. Yet it also has to be rugged and strong enough to assure the launcher's availability for subsequent firing.

N-A-XTRA steel meets all the conditions of light weight, high strength and impact resistance. Founded for precisely this purpose, the company has the know-how of certain steel. They are used, not only in the mobile missile launcher, but in many other defense products and in nonmilitary equipment such as earth-moving vehicles, heavy machinery and passenger vehicles.

Fabrication qualities are an N-A-XTRA bonus. Even at extreme temperatures, they remain tough and readily weldable. Conventional methods—cold drawing, gas cutting, shearing and notching—give superior results, too. For further information, write Product Development Department, Great Lakes Steel Corporation, Detroit 29, Michigan.



**GREAT LAKES STEEL**  
Detroit 29, Michigan

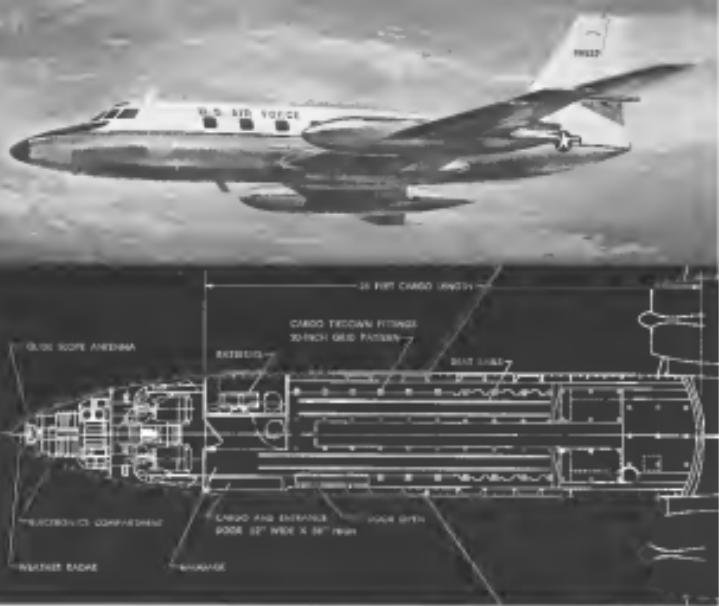
Quarried and tempered N-A-XTRA, the best hot-rolled armor-steel alloy steel you can buy, are available in four levels of strength. The 100,000-psi grade is used in the hull of armored vehicles. The 110,000-psi grade is used in the hull of armored and armored transporters and can be easily and rapidly welded. Sheet range from 3/16" to 2" thick, up to 12" wide and up to 15' long.



Steel for the STEELMADE  
in the products you buy, place  
or use the products you sell.

Great Lakes Steel is a Division of

**NATIONAL STEEL CORPORATION**



# UTILIZATION

The Lockheed C-140 JetStar's high speed and long-range capability give it a much higher rate of productivity for mission support than aircraft now in service. The C-140 is versatile; its pressurized cargo compartment provides flexible arrangements to transport passengers, priority cargo, or specialized equipment. And the C-140 is economical; the modernization of mission support fleets—by replacing obsolete aircraft with JetStars—can save millions of operational dollars.

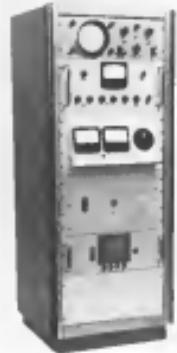
# LOCKHEED

GEORGIA DIVISION • MARIETTA, GEORGIA

components in selected circumstances. Such factors as cost have an important bearing on the design of a new equipment for space projects, especially those long life tasks associated with satellites which will be exposed to appreciable total radiation damage over long periods in the Van Allen belts. Then there have been regarded as promising for use in space applications because of their light weight, small size, low power requirements and ultimate reliability.

## NEW AVIONIC PRODUCTS

• **B.H. Meter**, Model 611B, graphically displays the location of tape or segments on an oscilloscope. Direct reading calibrated range of sample tape from 1 to 1,000 microseconds with a maximum sample diameter of



1 in. The meter can measure absolute time and resonance or flux at an arbitrary point. Meters may be purchased at \$3,000 each on a 90-day delivery basis. Manufacturer: Scientific Atlanta, Inc., 2167 Peachtree Rd., N.E., Atlanta, Ga.

• **X-tended voltage tunable magnetron**, Type Z-9425, provides continuous range of 1 milliwatt CW power. Frequency range of 5.5 to 11 GHz. Tuning rate is 9 arc per volt. Minimum anode voltage is 7,000 v. The complete RF package weighs 4 lb. and can be conduct or mounted at 5 in. x 6 in. for operating at ambient temperatures up to 50°C. Sample quantity price is \$1,300. Manufacturer: General Electric Co., Power Tube Dept., Schenectady, N.Y.

per lb. threshold is 4 ft. at 60,000 ft. Drag-off distance is 3.75 x 4.75 in. Transient provides an output, operates from -50 to 170°C and is suitable for use in aircraft autopilot systems, fire control and drone guidance units. Manufacturer: Guidance Controls Corp., 1608 S. Main Street, Denver, Colo.

• **Transit RF attenuator**, Model TAD-90, provides zero to 99.999 attenuations in one-step at frequencies ranging from 4 to 1,200 mc. Two knobs permit setting of attenuation in decade and next values with total attenuations and out to a hundredth number. Attenuation is quoted at 0.7 dB at 100 mc, 0.5 dB at 900 mc in the 0.10-100



• **Spring-driven tape gyro**, Model 2G14, measures operating speed within 100 microseconds after microswitched at least mechanically is operated. Intended for use in expendable devices and missiles, gyro operates over temperature range of 0 to 50°C, up to 15,000 ft altitude and reportedly meets MIL-E 5272 vibration requirements. Goya weighs 15 oz. Manufacturer: Flometrics, Inc., 2801 Corrine St., San Diego, Calif.

• **Electrostatic linear velocity**, Model 1173, capable of measuring dc voltages in the 0.10 v. range or as high as 0.50,000 v., has an input resistance of 10<sup>10</sup> ohms maximum and does not require AC. Accuracy is within 2%, stability is better than 2% in 24 hr at 60° heat temperature, and repeatability is

range. Above 20 ohms, accuracy is 2% plus minus 0.2 dB up to 200 mc and 3% plus minus 0.1 dB at 500 mc. Response less than 0.1 dB up to 100 mc, 0.4 dB at 500 mc. Power rating is one watt. Price is \$725 in single-lot quantities. Manufacturer: Telonic Industries, Inc., Beach Grove, Ind.

• **Substrate operational amplifier**, Model 1801, provides high gain, wide bandwidth and chopper stabilization. Total dc gain is greater than 100,000, frequency response from 0.1 to 300 kc, input drift is 1 namp / 90°C change, out



quoted at 15%. Instrument can be used to read capacitor voltage without discharge after peak voltage is reached, using a filter application. Manufacturer: K. K. Electronics Manufacturing, 4440 Fox Hill Ave., Denver 16, Colo.

• **Attitude control transducer**, Model 5960, designed for attitude control applications where a small unit, ruggedized, low threshold and high sensitivity are desired. Sensitivity is 4 arc ± 5%

per ± 10 volts at 4 rad/s load current, ±10 volts at 2 rad/s. Amplifier measures 3.5 in. long, .75 in. high, .5 in. thick. Price is \$400 and delivery can be expected in 45 days. Manufacturer: Danner Scientific Co., 185 Callejo St., Concord, Calif.



# FINANCIAL

## Martin Proposes Stock Split

Martin Co. shareholders will be asked to approve Jan. 9 an increase in authorized capital stock from 10,000,000 to 12,000,000 shares to provide for a 2-for-1 stock split and for future acquisitions.

Until now, Martin's acquisitions have been on a cash basis. Initially Martin has been buying interests in General Precision Equipment Corp., but in acquisition of a candidate for the GPE board was not paid out.

Since 1985, Martin has not been actively acquiring any GPE blocks, but it has been buying interests in Nuclear Corp. of America. It acquired options in September to buy 35,000 shares to bring its holding to 773,165 shares. Martin was instrumental in the selection of David A. Thomas, former Nuclear Corp. of America vice president to Nuclear Corp. chairman. Electronics Engineers Bureau of Missouri also has a Nuclear Corp. interest in Nuclear and is a key holder. Martin directors

Morris Gould, 100% of Nuclear's stock options, and 100% of its cash and cash equivalents received of the options. It does not have sufficient resources, already Bear Stearns & Co., a New York investment house that underwrites a bond issue for Martin, ten years ago, says the increased options a timely point in Martin's bid to holdings to 400,000 shares.

Nuclear Corp. has sufficient interest of interest to Martin and is doing work in arc earth and high voltage diode tube areas that might be used in Martin's nuclear operation.

Martin directors also approved a quarterly cash dividend increase from 40 to 50 cents a share on shares now outstanding. Stockholders do not have to approve the stock split itself, but the increase is necessary to provide enough shares. Martin now has 3,077,607 shares outstanding.

Thomas Electronics Corp., Cambridge, Mass., has announced new financing arrangements which will provide \$2 million per quarter in the next 12 to 18 months. Financing, which included both stock purchases and convertible debentures, was with a group consisting of Lawrence S. Rockdale, James Bush, New York investor, Lehman Brothers, investment banker, and Peter M. Nankin, a company founder. Thomas Electronics' interests is in research and development and manufacture of direct energy conversion devices.

Bowman Instrument Corp., Ft. Wayne, Ind., reported earnings of \$132,656, or 50¢ per share, for the year ended Sept. 30. This compared with earnings of \$81,728 or 30¢ per share for the previous year.

Micro-Mechanisms Co., Bedford, Calif., specialists in aircraft landing gear, hydraulic systems and power control, has acquired Micro Gear Products, Inc., Cypress, Calif., manufacturer of power amplifier, pressure controls and electro-mechanical flight simulation tables for testing aircraft. Micro Gear was formerly a subsidiary of Lenco Electronics, Inc., Los Gatos, Calif., which acquired Seacore Valve Co., South Pasadena, Calif., manufacturer of automotive control valves.

With the growth of technology, plus added, has come a corresponding increase in costs and Northrop has established a system of managing costs and the earliest stage in the formation of a company. It takes the most cost-effective approach to find the weakest solution, Jones said, but the company that can provide the desired solutions to difficult aerospace problems at a reasonable cost will win business.

One way Northrop seeks that capability is in indoctrinating technical people with the requirements at least now and with technical people with knowledge of technology, Jones said.

Nothing has put a segment of its cost control program to us, by raising its Nasdaq Division Performance and Cost Reduction (PAC) program aable to other companies on a fee basis.

## Financial Briefs

Some initial post-October system in Wall Street short-term corporate bonds is cooling off. Analysts now are beginning to look back and say to be shown signs of recovery, notably stocks in the aerospace and the semiconductor market. The company is organized around fundamental technical ca-



## CANNON MS PLUGS

**MEET THE MOST SPECIALIZED AND STRONGEST DEMANDS**—Cannon MS Plugs are built for rugged service! From general duty ground use to specialized military applications, these plugs fulfill the requirements of mil. C 9015 and are suitable for many commercial and industrial applications where quality and dependability are required. Our full line of environmental sealing MS plugs gives you the optimum in interchangeability, variety of contact arrangements, and shell types and sizes. The MS series, MS-A, MS-B, MS-C, MS-E, MS-R, MS-H, are available from authorized Cannon Distributors everywhere, or write.



CANNON ELECTRIC COMPANY • 2800 Humboldt St., Los Angeles, Calif.

# NEW ANSCO INDUSTRIAL X-RAY CALCULATOR SOLVES TECHNIQUE PROBLEMS AT A GLANCE

Here's an all new calculator designed to correlate all factors in industrial x-ray techniques and give working answers as fast as you can move the slides.



- PREVIOUS COMPLETE INFORMATION
- READS ALL ON ONE LINE
- READS FROM TOP TO BOTTOM

#### Solves problems in:

- exposure determination.
- film speed-density relationships.
- exposure compensation for density changes
- choice of film to meet scheduling problems.
- techniques for multi-thickness specimens.
- exposure compensation for kilovoltage changes
- sandwich techniques.
- density determination for various metal thicknesses

In the shop this new calculator rapidly provides information for solving new problems in the classroom it gives students a visual working relationship with any exposure parameters.

AnSCO, Braddockton, N. Y., A Division of General Amiline & Film Corporation

ORDER YOUR  
ANSCO X-RAY CALCULATOR  
DIRECTLY FROM:  
SOCIETY FOR  
NON-DESTRUCTIVE TESTING  
1109 HINMAN AVE., EVANSTON, ILL.  
PRICE \$10.00

**AnSCO**  
X-ray

# BUSINESS FLYING



**TWIN BONANZA** for 1961 has enlarged nose for weather radar equipment; new window has been added at side centerline.

## Beech Pegs 1961 Sales at \$77 Million

By Bruce J. Bellon

Wichita, Kan.—Beechcraft aircraft sales last year were more than \$77 million, down as a 10% material objective.

That should be easier to reach this year, the goal is \$80 million. Beech Aircraft Corp.'s domestic and international distributor and dealer organization has shown a pattern of the 1961 model. Beech

Sales group last year topped the year previous, \$60 million in '60. In \$2,416,000. Since \$52 million of the total was in domestic sales, approximately \$10 million was export sales.

Potentially, aircraft in Beech business aircraft sales last year over 1959 was "modest" since that year had been interrupted by strikes. W. Ernest Hixson, president marketing and distribution and dealers, adding that "as a growing market that we, now, enjoy, it was a good job, but it wasn't outstanding."

Nonetheless, the company's volume increased 23%. It was vice president Michael G. Neuberger's report sales team that really set the new record—a 1961 increase in business. The German distributor, Fischer-Grafitt, shipped off most Decca Avion and had two more on order in that country. The pent backlog is \$1 million up 50% from last year.

Indications of how Beech proposes to get its percentages still higher were evi-



**ORANZA 11B** has large new windows for 1961; nose or cockpit window has been modified. Below is the Vega 11B, which has a new picture window added to either



# NEW WEBER AIR CARGO "UNITIZING" CONCEPT!!!

In the new "Global Jet Age" there is great demand to compact and to contain heterogeneous items into shipping modules or units. Weber's Unitizing Concept efficiently utilizes all cargo space, insures rapid assembling, loading, unloading delivery.



Cargo Container - Contained in Cargo Compartment - Shipper can fit it



Air Cargo Pallets - Rugged, light weight, Numerous design options and features



Combination Box unitizes and stores numerous small shipments

The new Air Cargo System Development Department will further diversify the Weber General Support, Missile and Aircraft product capability. Weber is also your one source for Escape Systems, Aircraft Seating, Galleys, Living Quarters, in fact, all aircraft interior equipment.



**WEBER AIRCRAFT CORPORATION**

Subsidiary of Elbit Electronics America, Inc. 2828 Ontario Street • Burbank, California • P.O. Box 226

short during the season. Highlights in:

- Shipping of 1961 line, new marketing eight engines, with addition of the new light twin, the Model 35. Item (AVN Nov. 21 p. 30).

- "Tow-hes" facilities package program for dealers that is aimed at easing the task of cataloging the sales organization. Company plans to add some 200 new dealers in the next three years.

- Increased emphasis at Beech parts and accessories business. Beech is only scratch the surface here and giving a "gold mine" in various business areas in function without a hardware store in the company. Henry noted.

Barometer of the projected business volume was Beech's ST15 when he took over the company. The showing is 27% of the 1961 total.

These are encouraging signs, but some questions of where the company is heading are given. Answer: With its executive vice president Paul F. Hedrick, developing and the management plans on next larger airplanes.

- Turboprop engines on the answer to the business aircraft industry's "need to get out of the 200 mph box we have been in," he said, pointing out that long-range engines in piston engines are as small that hardly enough performance increase is gained in pitch than increased cost. These manufacturers now need a big increase in power to provide gains in both payload and performance and the major engines provided by current piston engines make possible the flight distances of one or the other, but not both, in their current configuration.

- Turboprop power will free the designer and builder of these performance shackles and open long-haul passenger performance into the air route through to high speeds which equates in quantity with jet transport travel will render competitive, plus the smoothness of turbine power that the customer now is requiring is welcome.

- Developments in current small turboprop models that the slowdown in these engines will be much less expensive than initially contemplated in a very important area. Hedrick said. It appears that it will be possible to expand the current line of Model 35 and 36 propeller aircrafts in the 10,000-12,000-lb. "all-haul" range by exploring which should now be off in obtaining a sequence for math and weight conservative color presentation.

- It is necessary to look at high cost of going to pressurized cabin. This initial cost of a high-speed aircraft will come into a completely different area and aircraft builders should be able to lead this market with much more confidence than they had under previous lower costs will mean a larger payload and lower fuel cost.

Next step of turboprop to be built



**DEMONSTRATION** has had a useful load increase of 25 lb. New air has been added and these part schemes are offered this year. Model 35 is priced at \$11,700 an increase of \$1,200.

In Beech will be what is now called around the plant the "King Air" — Queen Air with turboprop. This airplane should start flying in late 1962 or 1963, according to present planning. Hedrick said. To explain the name to the press, "King" will equate to the size of the plane, "Air" to design, "Queen" to the new fuel system and "King" to the "King" class.

In the interim, Beech is studying the possibilities of using the rest of the current development by the French firm SIFERMA with the French Air Force. SIFERMA is the French equivalent of the American Farnborough. Beech has work to focus market potential of the turboprop-powered French Air conversion. Indications are that sufficient customer interest develops, Beech would supply. Until then, Beech refers to SIFERMA for supplies of urgent French Air for foreign customers.

For this function, SIFERMA would supply engines in Beech for installation on the Travel Air line in Wichita.

Such an arrangement would need to minimize delivery delays in the interim, since special assembly lines probably would not have to be set up in Wichita. This would, further, reduce the cost that would be applied to appropriate advances already moving down the annual lists.

## New Airplanes

Indeed, the focus on Beech work or further diversification in line on the lower-end of the price scale before the Demonair. A decision has been made to the turboprop will be in the \$15,000 price class. At least two factors have prompted this move, he indicated — first belief that the next airplane would be in the \$15,000 price range, with changed feature reductions will that it would be a quick increase in price to the point where it would be competitive in the Demonair. Indicating further, Beech has come to the new class. Hedrick noted, "we have built some business," referring to the \$15,000 price class airplane. This apparently will be scrapped.

The other factor which actually be-

# GRAPHITAR<sup>®</sup>

—CARBON-GRAPHITE

THE VERSATILE ENGINEERING MATERIAL  
THAT POSSESSES MANY UNIQUE AND PRACTICAL  
ADVANTAGES FOR A VARIETY OF APPLICATIONS

**MINIMUM LUBRICATION REQUIRED**—Because of the controlled porosity and non-melting nature of GRAPHITAR, the only lubricant GRAPHITAR bearings need is water or other low-viscosity fluid. Any such fluid with non-penetrating characteristics will provide an extremely low coefficient of friction and assure long life of the GRAPHITAR parts.

**RESISTANCE TO CHEMICAL ATTACK**—GRAPHITAR has the ability to withstand the action of almost any chemical, with the exception of most highly oxidizing reagents in hot and concentrated form. GRAPHITAR parts, for example, operate efficiently in water, chemical and gas valves to provide a corrosion resistant material operating under the most adverse conditions.

**MECHANICALLY STRONG**—GRAPHITAR will not warp or distort even at high pressure applications. Compressive strength up to 45,000 psi and uniaxial breaking strength from 3000 to 16,000 psi, depending on the grade.

**HEAT RESISTANCE**—GRAPHITAR is not affected by heat under normal or reducing conditions. Temperature of oxidation for most grades is approximately 700 degrees F. In addition, GRAPHITAR engineers have developed a special oxidation resistance grade of GRAPHITAR that has been

exposed in an oxidizing atmosphere (air) of 1200 degrees F. and after 200 hours, it showed a weight loss of less than six percent.

**MOLDABLE**—GRAPHITAR has excellent moldability properties that make possible and precision cast all shaped parts. Design requirements such as ears, fins, slots, and concave diameter notches can easily be incorporated into GRAPHITAR parts without secondary machining and finishing operations.

**MACHINING**—The United States Graphite Company operates an excellent finishing department to do all finishing operations to the most exacting specifications. GRAPHITAR may be ground in air or shaped with a range of carbide or diamond tipped tool in references to class in JIS 0555\*. When surfaces require a high degree of precision on flat areas, lapping and polishing equipment are employed and accuracies within three light bands can be produced.

**LIGHT WEIGHT**—GRAPHITAR is lighter than magnesium and is being employed increasingly in the aircraft and missile fields. The weight per unit volume of various GRAPHITAR grades is as follows: 102 E to 116 D pounds per cubic foot, .0595 to .0672 pounds per cubic inch, 932 to 1,074 ounces per cubic inch.

Write today for Engineering Bulletin No. 20

## THE UNITED STATES GRAPHITE COMPANY

W DIVISION OF THE RICHES CORPORATION, SAGINAW 5, MICHIGAN  
GRAPHITAR<sup>®</sup> CARBON GRAPHITE • GRUMIX<sup>®</sup> POWDER METALLURGY • MEXICAN<sup>®</sup> GRAPHITE PRODUCTS • USA<sup>®</sup> GRAPHITES



### Check List Junior

Hughes Inc., Paines, Okla., manufacturer of rugged check lists for military and transport planes (Refer to our design of Check List Junior in the last sophisticated aircraft) has developed by building and layer on specific hardware check list items. Price range from \$14.95 to an eight-bit model, to \$79.95 for 12-bits.

Some apparent after the company had decided to drop the \$15.95 project and concentrate the \$14.95 type, was greater acceptance of the latter in engineering worlds, where dollar shortages make sales of tooling appliances difficult.

Both apparently plan to exploit possibility of having the check list produced abroad, in addition to producing it in Wichita. High-level sources say that the company will complete agreements now open, with two countries as soon as the new machine manufacturers.

New low-cost capsule will be closely to check aircraft's plan to greatly enlarge its aircraft inspection maintenance program. It is planned for the company to decide to start business in a new area where presented is not fully known, with a modest acquisition by capital investment in demonstration.

### Product Line

In the decade and a half that the project has been in the future their immediate tasks will come from the hardware displayed during the meeting here in Wichita. The 1961 line showed modest improvements, aimed at narrowing requests from field sites staff members for changes. Indication that difficulties and design for first time will have a heavier use is shown in an order backlog of \$140,000 for 250 implants.

The expanded, eight model 3451

## JR. & SR. ENGINEERING WRITERS

### NON-SUPERVISORY SALARIES TO \$11,500

One of the most challenging and rewarding engineering writing assignments ever offered and now available is Hughes-Fullerton in Southern California.

There are important production, 44 projects involving the entire spectrum of projects within in the technical field.

**Military Handbooks**  
**Technical Proposals**  
**Engineering Reports**  
**Space Engineering Brochures**

Opportunities will develop as possible expanded opportunities for project as well as lesser engineering writing assignments such as

**Technology Briefs**  
**Digital Computers**  
**Digital Data Processing Systems**  
**Design Display Systems**  
**Integrated Missile Defense Systems**

**BASIC REQUIREMENTS INCLUDE:** an intense professional interest in communications in all fields— from film to missiles, a demonstrated ability to produce written material that is clear, concise, accurate, educational, stimulating and appropriate to the challenge (writing, design, or equivalent) in engineering writing experience.

Located in Southern California's Orange County (the nation's fastest-growing aerospace center), Hughes Fullerton offers a stimulating, professional working environment and long-term stability.

### call collect today!

For complete information on these opportunities, send resume with a portfolio of recent writing work to: Mr. J. C. L. Johnson, 4475 Thruway, Suite 400, Fullerton, Calif. 92632. Equal opportunity employer. M/F/H/V. U.S. Postage Paid. Fullerton, Calif.

**HUGHES**

Space & Communications



# Only Complete Line of Fire and Overheat Detection Devices...



Only Fenwal's complete line of detection systems covers all forms of fire and overheat danger in aircraft, missiles, and space craft. Only Fenwal covers all "Aviation Sensors".

Fenwal Detection Devices include: Unit Detectors for "spot" protection; Continuous Fire Detectors for positive coverage of large areas; and the latest Fenwal advances — FIDCO (Fire Inspection Device Optimal); and the Surveillance Detector (Photocellactive device, sensitive to flame or to heat radiation). Advanced says to "see" fire!

And Fenwal contributions to safety in flight go beyond the detection phase. Fenwal also designs Explosive Suppression Systems for protecting both airframe and contractual aircraft. A Fenwal engineer will be glad to assist with your particular detection or explosive protection problems. Write FENWAL INCORPORATED, 1216 Pleasant Street, Allston, Massachusetts.

können diese an, so ist es offiziell bei beiden Modellen.

• New Model 55 Burns, a 16-place light twin, powered by two fuel injection 250 hp Continental IO-470 L engines. The gross weight of the basic airplane is 3,715 lb. Airframe can be leased for \$1,154 per month including liability and full coverage. Maintenance plan provides for rentals of \$1,215 per month which includes full insurance. Burns grosses out at 4,850 lb. and has a useful load of 1,970 lb. Range provides some 140 to 150 miles for cabin and baggage compartments. One baggage compartment, in the rear, has 11 cu. ft. capacity, and there is a dedicated baggage station in the rear of the cabin for a total of 45 cu. ft. Standard fuel capacity is 522 gal. 140 gal. — 5 cu. ft. is available as an optional component. Full gross weight maximum capacity rate of climb is said to be 1,630 fpm, while single engine rate of climb is given as 305 fpm at 4,000 lb. gross. Service ceiling at gross weight is 19,760 ft. Single engine ceiling, max weight is 15,000 ft.

• Travel Air 895 was not shown during the meeting, since the 1961 model will not be available until some time in March. Berth officials emphasized that this airplane is being considered as the line. Specifications are that the plane will do 26,500 lbs.

• Debonair four-place, press'd at 822,770 pounds, 75 cu. ft. useful load maximum. Addition to more 20 ft. of optional street nose incorporated is standard which accounts as part for the



## Meyers OTW Used in New Motion Picture

Meyers Model OTW biplane former, first flown in 1939, is used in a wild horse herd scene plane in a new United Artists motion picture, "The Mustangs." The plane was loaned to director John Wayne, New Mexico, and is used in a scene of 8,500 head of horses, 100 by 150 feet, to show in Col. Ken Saylor (as script) who still commands the range. The plane was a 12-year-old World War I pilot who still commands the range. The airplane was deliberately scuffed with sand to give it a "weathered" appearance. The OTW was developed by Meyers Aircraft Co., Tecumseh Mich., which recently is running production of its Model 145 bi-seat lightplane (AIAW Oct. 24, p. 510).



work in the fields of the future at NAA

## PROPELLION DEVELOPMENT ENGINEERS

Challenging new programs in aerostructures and naval briefing projects offer exceptional opportunities for propulsion development engineers. Current Projects require engineers interested in:

- Engine Cycle Analysis
- Fuel/Fluid Systems
- Dynamic Controls
- Secondary Power
- Hazard Protection
- Failure Analysis

For more information please write to Mr. A. M. Bowman, Engineering Personnel, North American Aviation, Inc., Los Angeles 45, California.

LOS ANGELES DIVISION  
**NORTH AMERICAN AVIATION** 



## CUBIC AGAVE CHOSEN FOR PROJECT MERCURY TRACKING!

Cubic Corporation has been selected by Bausa Corporation to build AGAVE antenna tracking systems for the National Aeronautics & Space Administration's world-wide Project Mercury tracking and general instrumentation network. These systems will be used to track the Mercury capsule over the oceans, land and, subsequently, supply pending information to index, telemetry antennas and tracking transmitters.

Mobile precision tracking systems, high accuracy and long range operation, by using narrow beamwidths, these systems will be able to track the capsule over the following of (1) initial target acquisition and (2) reacquisition if the target is subsequently lost. AGAVE combines a broad 30° beamwidth with superior pointing accuracy to permit narrow beam tracking devices. Components were correlation detection and the 10-bit gain of the antenna array provide

mobile tracking over a 3000-mile range with only a 1% weight penalty versus in the target.

**OTHER USES:** AGAVE can also serve as a self tracking telemetry antenna. The front-end passes the entire 225 to 265 mhz telemetry band. One AGAVE antenna can track the capsule and receive the capsule data. AGAVE provides complete position data. AGAVE features the best of an ideal antenna as a fully redundant dual guidance system.

For more information on AGAVE, please write to Dept. AW-6, Cubic Corporation, San Diego 11, Calif.



AGAVE (Automatic Globalized Antenna Tracking Equipment)

price increase of some \$1.27 a lb. to continue production. 1961 Delorean will have the factory in excess of three point releases at standard price. New engine has wider air inlet, increased engine air exhaust at rate of eleven sec. from an inlet exhaust at the rear with fuel tanks and canister. Fuel tank which formerly had color and the tank was 1 cubic foot. Estimated production cost \$27 million in Delorean has revised this estimate to over \$3 million.

• **Buick:** NTB, selling for \$26,000 in its base configuration, has an increase of 13% in weight, lead and grosses at 3,225 lb. Length and width are greater than the NTW. Buick's a 13% increase in transportable cabin area for a total of 28 sq. ft. Front and rear seats have a maximum of approximately 15 in.

### Plane Modifications

Buick and Delorean this year have had a slight modification to the control system, with a hub cap incorporated in the hub between control wheel and floor, increasing cluster spring tension requirements and providing greater stability.

• **Fiat-Berlina:** is continued in two models as 1961. The 110 with two supercharged engines, 140 hp. Lancia using 1350-180 V16 engine, geared at 5700 rpm in the basic model, and the 1400, powered by high compression 291 hp. Lancia engine, GD-493-G276 powerplants which will total at 587-590 in the standard version. Revised instrument panel, conforming to 36 acts of Automotiva. Ignition switch criteria for instrument placement in basic "T" configuration also has been lowered and wood based appointments 1 on an increase except wood grain. Additional wood panel brackets added to the left side of cabin area to support 1000 lb. weight.

• **Spitfire:** Gull Wing, which is available in \$43,500 in the basic version, has been modified and now features a picture window on each side of the cabin for improved passenger visibility. Improvements are: 1. In using further improvements being studied by British for this airplane, are fuel injection engines. However although we like this idea and are looking at some that introductory costs further requirements. Model 18 which now is in 46.2nd continuous year of production is a leading automobile for the company and last year some \$15.5 million in total volume, was released in Model 18 sales from the airplane's first year that the last year was 10,000 units. 2. Model 18 Queen Air, which sells for \$226,000 in the basic model is similar to last year's version with minor styling changes.

Bentley Aerospace Corp., which

AVIATION WEEK, December 5, 1960

# the fifth Freedom



sparks advanced  
electronic R&D  
at Amherst  
Laboratories

Computer can simulate fighter form and distance. The ideal formula for creating jet performance determined. However, at Amherst Laboratories, programmatic knowledge of the dynamics of flight is not limited to the dynamics of the mind. It is applied to the dynamics of the world.

To society, it is freedom of thought. To science, it is freedom of thought. To government, wherever the role, it is essential to Amherst Laboratories. Research can prevent the day of reckoning. It can contribute to the ever increasing backlog of prime assignments in advanced Ground, Air and Space Communications.

**PROFESSIONAL STAFF AND MANAGEMENT OPPORTUNITIES** are available for Physics, Mathematics and Electronics Engineers with advanced degrees and creative ideas.

You are invited to direct inquiries to: Dr. R. L. Sam Turner, Amherst Laboratories, or call NP 3-3133 for information. All inquiries will be acknowledged promptly.

SYLVANIA ELECTRONIC SYSTEMS  
A Division of SYLVANIA

Selections of OPTICAL,  
TELEPHONE & ELECTRONIC  
PRODUCTS

200 Main Street, New Haven, Connecticut

**A**  
**AMHERST**  
**L**  
**ABORATORIES**

Shrinking the Universe... Through Communications

Ask anyone,  
anyone  
you're trying  
to sell in the  
aerospace market,  
what publication  
he reads and  
respects most.



A powerful editorial force is a powerful selling force

**Aviation Week**  
*and Space Technology*

A McGraw-Hill publication 2001 Newsstand \$15.00 U.S. \$19.00 Canada

ABC PAID CIRCULATION 75,000



**jpl****LUNAR and PLANETARY  
COMMUNICATION****SENIOR RESEARCH SPECIALISTS**  
Some specific openings now availableCommunication Specialists  
Executive R&D leading and  
communications system expertsR&D Research Engineers  
Design of advanced R&D  
instrumentation/equipmentAntenna Specialists  
Analysis, design and evaluation  
of ground and space antennas and  
Space ServicesResearch Scientists  
Digital data and encoded system  
analysis, test systemsMathematicians on Communication System Analysis  
Analog and digital system analysis, noise, coding in  
Terrestrial, Deep Space and non-linear filter theorySeveral openings also exist for supervisors of Research and  
Advanced Development Projects performed by industry for JPL.Sandia complete qualification review now  
for immediate considerationCALIFORNIA INSTITUTE OF TECHNOLOGY  
**JET PROPULSION LABORATORY**  
PASADENA, CALIFORNIA

euised corporate finance organization  
reported last year the largest ever  
in a dot-com business of \$17,261,854  
in corporate financing with 265 units  
value at \$51,615.467 face placed in  
distribution and choices and 179 units  
bundled on line and on retail financing  
plus with a total value of \$5,  
367,513. Since inception of finance  
plan by JAMC, the company has face  
placed 1,018 appliances for a total dollar  
volume of \$18,365,773 and has bundled  
561 retail contracts and leases for a  
dollar volume totaling \$13,732,368, vice  
president-general manager A. R. Bell  
reported.

**PRIVATE LINES**

Piper Jaffray Co has selected the  
two-engine training at new College  
of Air Training at Bunting, England.  
Nine aircraft have been ordered from  
Vigilant Aviation, Ltd., Bunting dealer  
at Oxford; first six will be delivered  
and June. College provider flight and  
ground training for students who will  
become pilots for British Airways Air-  
ways Corp. Program involves six weeks  
of ground school, 150 hr of single en-  
gine flight training in de Havilland  
Chieftain, and 75 hr in Apache Super  
Carters twin.

Austalis Radio Corp., Dorseton, N.Y.,  
has broadened its communications-navigation  
line to penetrate the multi- and  
single-engine, trainers, phase, market.  
Line seven Starfire 3 multi control  
equipment for multi-engine planes, and  
Starfire 1, local control, parallel  
mounted control-as-unit for light twin  
and heavy single engine planes.

Cessna Aircraft Co held its interna-  
tional export management conference  
Nov. 27-30 at São Paulo, Brazil, to  
introduce marketing plan and show the 1961  
line.

Future plans covering introduction  
of existing aircraft models through  
modernized line lots, further distributed  
activities and exchange regions, have  
been developed by the Brazil Aircraft  
Corp.

Piper delivered an October totalled  
59 aircraft with a better net billing of  
\$1,116,000. Included in shipments  
were 27 PA-28 Super Cabs, 11 PA-22  
Tri-Pipers, three PA-31 Aspens, 13  
PA-32 Aspens, seven PA-24 Comanches  
1960, six PA-35 Pawnees, and seven  
Airspeeds to U.S. Navy.

All-weather Mooney Model 22 four-place  
airplane, given an improved Model 20  
with all-metal wings, will be announced  
by Mooney Aircraft, Inc., in mid-De-  
cember.

**WHO'S WHERE**

[Continued from page 25]

**Honors and Elections**

E. H. Park of H. F. Gosselot Aviation  
Products has been elected president of the  
Aviation Displays and Measurement  
Division of the Fairchild Aerospace and  
Defense Division of the United ADATS was  
president. George E. Copeland, Vice Director  
Aviation Displays Int., and H. William  
Clegg, Licensing Division of Avion Corp.  
Dr. Peter C. Gallaher, physicist and  
former director of the Space and Earth Sciences  
Div., has been named the Vice President & General  
Manager of the Space and Earth Sciences  
Div. Licensing Division of Avion Corp.  
Dr. Ralph C. Goldsmith, physicist and  
former director of the Space and Earth Sciences  
Div., has been named the Vice President & General  
Manager of the Space and Earth Sciences  
Div. Licensing Division of Avion Corp.

**Changes**

A. M. Scott, manager sales and service,  
Aero Engineering, Roll-Royce of Canada, Ltd.,  
Montreal, Quebec, Mr. Scott con-  
tinues as chief engineer.

Raymond A. Raggio, director of engine  
operations, Pratt & Whitney Canada, assumed  
Charles S. Blasberg, manufacturing special-  
ist, American Machine & Foundry Co.

Reinhard L. Stroh, manager of General  
Electric's Special Programs Section, Defense  
Systems Department, Radnor, Pa.

Dr. Ralph F. Motte has been appointed  
chief scientist at the Bellanca Science  
Center, North Bellanca, Okla., of Hawker  
Hobbies Corp.

J. Patrick Murphy, present sales manager  
General Aircraft Supply Corp., Detroit,  
Mich., a subsidiary of Amoco Corp.

Lesley M. Hobbs, manager of control  
systems and manufacturing, Inc.,

Ray E. Rowley, chief engineer, Bendix  
Flight Divisions, The Bendix Corp., Madison  
Heights, Mich.

Joseph H. Hirsch, director of Midas pro-  
grams, Aragon Control Corp.'s Aragon Div.  
Inc., Milwaukee, Wis.

May, Gino, Rinaldo of C. Meade (USA),  
Inc., has been appointed to field operations, Phoenix  
City, a Government and Industrial Group,  
Philadelphia, Pa.

Harry R. Gilstrap, assistant general sales  
manager, Transport Div. of Boeing, San  
Francisco, Div. of Boeing Co. And C. A. Austin director  
of sales, Mr. H. D. Willis, manufacturing  
operations manager.

William S. Cade, project director,  
Space and Engineering Department, Jacobs  
& Associates Washington, D.C., a division of  
Alliant Research Corp.

Dr. Martin C. O'Neal, formerly manager of the  
two-degree program, will teach in Los  
Angeles England.

G. Gordon Prentiss, contract manager  
Interglobe program, Convair, Interspace  
Division of General Dynamics Corp., San Diego, Calif.

E. E. Roberts and J. F. Clegg  
assistant manager Solid Rocket Propul-  
sion Group Control Corp., Sacramento, Calif.  
Also Dr. Karl Klinger, senior division man-  
ager Solid Rocket Development, Dr. G. O.  
Kleber, senior division manager Solid  
Rocket Research.

**Electronic Systems  
Engineers**

here is your opportunity to join an expanding  
center of advanced electronic systems capability—

The Columbus Division of North American Aviation, Inc.,  
is a center of electronic systems capability. It is the  
designer and builder not only of aircraft—such as the A3J  
Vigilante and the T-33B Barkley—but also of missiles, radar  
antennas, radio telescope systems, seat ejection systems,  
special support equipment for future systems—such as the  
Minuteman, and other diverse products. The Columbus Division  
is also the center of extensive advanced R & D projects. Here,  
there are unlimited opportunities to contribute to  
advanced technology—and to forward your own career.

Currently, the Columbus Division has openings for Elec-  
tronic Systems Engineers. These engineers will assume  
responsibility for the development of electronic equipment  
for advanced weapon systems. To qualify for these posi-  
tions, a background in one or more of the following fields  
is required:

Design Processing and Handling  
Design of Electronic Checkout Equipment  
Design of Electronic Packaging (Controlled)  
Design of Large Digital Computers  
Design and Development of Transistorized Circuits  
Development and Design of Antennas (Aircraft and  
Ground Applications)  
Development of Microwave Systems  
Digital Programming  
Ground Communication and Shared/Essential Systems  
Operations Research  
Radio Systems Design  
Resonance Systems  
Solid-Electrostatic Electronic Test Equipment  
Sonic Systems  
Solid State Devices  
Systems Analysis  
VHF/UHF Antennas Development

Electronics Engineers who are qualified, through education  
and experience, and who are seeking better opportunities to  
technically express themselves in any of the aforementioned  
fields, please forward resume to:

Mr. W. D. McInroy  
Engineering Personnel Supervisor, Box AW-222  
North American Aviation, Inc.  
500 East Fifth Avenue  
Columbus 16, Ohio

**THE COLUMBUS DIVISION  
OF  
NORTH AMERICAN AVIATION, INC.**



**"one step beyond..."**

THE  
PRESENT  
TECHNOLOGY

If interested and qualified  
please forward your resume  
to Mr. G. E. Bailes, Assistant  
Chief Engineer, P.O. Box  
2840, Convair, Fort Worth, Texas

In preparing for the challenge of aeroospace  
in the 1960's, Convair/Fort Worth is ex-  
pecting a host of sensors, guidance  
and control, communications, data  
processing and information systems. We are  
looking for individuals to create the appropriate  
and capable of evolving advanced concepts  
and techniques both analytically and in the  
laboratory.



A Division of  
**GENERAL DYNAMICS**

CONVAIR / FORT WORTH



# Propulsion System and Power Cycle Analysts

Selected Opportunities for outstanding:

- PHYSICAL CHEMISTS
- MECHANICAL ENGINEERS
- CHEMICAL ENGINEERS

Write in confidence to  
MR. W. D. WALSH

Several select positions are now available in an analytical group engaged in performance analysis of systems that will represent significant advancements in the state of the art—advanced hypersonic air-breathing propulsion systems, nuclear power-cycle concepts for auxiliary space power-units, inter-transporter power-packages and central power-station equipment. Studies require objective imagination and a wide range of scientific and technical skills.

Programs are of the long-range sustained type and have excellent management support. Readily available are superior analog and digital computer services and coordinating efforts by experienced specialists with complementary skills.

These are attractive opportunities at a level that will interest outstanding technical men. Minimum qualifications include an advanced degree plus related experience.

**RESEARCH LABORATORIES**  
UNITED AIRCRAFT CORPORATION  
100 Main Street, East Hartford, Connecticut

## AIRPORT ANALYST

This is a permanent position in the Research and Development Department of the Thompson Ramo Wooldridge Group. The position requires a college degree in aeronautical or mechanical engineering, plus 5 years of experience in aircraft design, aircraft performance analysis, aircraft systems analysis, aircraft maintenance, and aircraft reliability.

Specific responsibilities include: the analysis of aircraft performance, aircraft reliability, aircraft systems, aircraft maintenance, and aircraft reliability.

James C. Buckley, Inc.  
Product and Transportation Division  
20 East 40th Street  
New York 17, N.Y.

## Need Engineers?

Check them through this

## EMPLOYMENT OPPORTUNITIES section

## IN ALL INTERESTS OF AVIATION

If You're important, you either read **AVIATION WEEK**  
or you advertise in it, or both

# R & D CAREERS AT TAPCO

Space-age opportunities exist at TAPCO-TRW for engineers and scientists in many fields of advanced technology. Challenging fields that include solar power systems, ground support equipment, missile APUs, high velocity nozzle systems, hydraulics and electrical systems, fuel cells and energy conversion, and magnetohydrodynamics.

Specific openings available for engineers experienced in:

- Thermodynamic Stress Analysis
- Hydraulics
- Cryogenics
- Reliability
- Centrifugal Booster Pumps
- Instrumentation
- Testing
- Turboachinery
- Liquid Metal Bearings
- Plasma Physics
- High Energy Fuels
- Biochemistry

The TAPCO Group of Thompson Ramo Wooldridge is assembling a strong R&D team to advance the state-of-the-art in these and associated fields. If you are interested in learning more about this organization and your place in it, send a resume to R. J. Theber, TAPCO Group Employment Manager, Cleveland 17, Ohio, Box No. N-3.

**TAPCO** A THOMPSON RAMO WOOLDRIDGE COMPANY  
**Thompson Ramo Wooldridge Inc.**

AVIATION WEEK, December 8, 1960



AT UNIVAC...  
OPPORTUNITIES FOR

# Transistor Circuit Designers

Immediate openings are now available at Remington Rand UNIVAC for Transistor Circuit Designers, as well as other professionals personnel who are seeking a better opportunity.

Investigate these opportunities and make your move to a better opportunity. The many facilities of a producer in UNIVAC's atmosphere of advancement.

### TRANSISTOR CIRCUIT DESIGNERS

Remington Rand UNIVAC is seeking experienced design with a minimum of 5 years actual experience in the development of state-of-the-art electronic circuitry.

Other openings include:

- COMMUNICATIONS ENGINEERS
- SEVEN ENGINEERS
- SYSTEM ENGINEERS
- INSTRUMENT ENGINEERS
- ENGINEER WORKERS
- MILITARY ENGINEERS
- RELIABILITY ENGINEERS
- QUALITY CONTROL ENGINEERS
- PRODUCTION ENGINEERS
- STRUCTURE & SPECIFICATIONS ENGINEERS

Send resume of education and experience to:  
R. K. PATTERSON, P.O. 918

# Remington Rand UNIVAC

Division of Remington Rand Corporation  
2350 Main Street St. Paul 16, Minn.

There are other unadvertised openings in all areas of digital computing assignments as our other advanced engineers should be interested in.

P. O. Box 717  
Remington Rand Corporation  
2350 Main Street  
St. Paul 16, Minn.

# FPD PROFESSIONAL EMPLOYMENT NEWS

PUBLISHED BY THE FLIGHT PROPULSION DIVISION OF GENERAL ELECTRIC IN CINCINNATI, OHIO / DECEMBER, 1960  
THIS BULLETIN IS FOR USE EXCLUSIVELY IN THE AIRCRAFT PROFESSIONAL FIELD. It is intended for experienced engineers and scientists. Technical advertisements and news relating to general products will also receive due care to come to the notice

# Technical Placement Manager Lists 17 'Most Urgent' Openings

The ever broadening field of Flight Propulsion Division's power and propulsion programs at Cincinnati, Ohio encompasses a variety of military and commercial aircraft propellers, as well as industrial and marine applications, development of advanced liquid rocket engines, electrical space propulsion and nuclear power systems, electromechanical and related electronic systems.

Engineering opportunities range over all areas of science, but the 17 positions outlined below are of particular interest at this time.

### Project Engineers—Rocket Engines

Remington Rand UNIVAC is seeking a Project Engineer with 5 years experience in the development of solid propellant rocket engines for its aerospace division.

### Rad. Testers

Remington Rand UNIVAC is seeking a Rad. Tester with 5 years experience in the development of solid propellant rocket engines.

### Flight Engineers

Remington Rand UNIVAC is seeking a Flight Engineer with 5 years experience in the development of solid propellant rocket engines.

### Flight Testers

Remington Rand UNIVAC is seeking a Flight Tester with 5 years experience in the development of solid propellant rocket engines.

### Flight Designers

Remington Rand UNIVAC is seeking a Flight Designer with 5 years experience in the development of solid propellant rocket engines.

### Computer Assemblers

Remington Rand UNIVAC is seeking a Computer Assembler with 5 years experience in the development of solid propellant rocket engines.

### Computer Operators

Remington Rand UNIVAC is seeking a Computer Operator with 5 years experience in the development of solid propellant rocket engines.

### Computer Programmers

Remington Rand UNIVAC is seeking a Computer Programmer with 5 years experience in the development of solid propellant rocket engines.

### Computer Analysts

Remington Rand UNIVAC is seeking a Computer Analyst with 5 years experience in the development of solid propellant rocket engines.

### Flight Engineers—Electrical

Remington Rand UNIVAC is seeking a Flight Engineer with 5 years experience in the development of solid propellant rocket engines.

### Flight Testers—Electrical

Remington Rand UNIVAC is seeking a Flight Tester with 5 years experience in the development of solid propellant rocket engines.

### Flight Engineers—Mechanical

Remington Rand UNIVAC is seeking a Flight Engineer with 5 years experience in the development of solid propellant rocket engines.

### Flight Testers—Mechanical

Remington Rand UNIVAC is seeking a Flight Tester with 5 years experience in the development of solid propellant rocket engines.

### Flight Engineers—General

Remington Rand UNIVAC is seeking a Flight Engineer with 5 years experience in the development of solid propellant rocket engines.

### Flight Testers—General

Remington Rand UNIVAC is seeking a Flight Tester with 5 years experience in the development of solid propellant rocket engines.

### Flight Engineers—Electrical

Remington Rand UNIVAC is seeking a Flight Engineer with 5 years experience in the development of solid propellant rocket engines.

### Flight Testers—Electrical

Remington Rand UNIVAC is seeking a Flight Tester with 5 years experience in the development of solid propellant rocket engines.

### Flight Engineers—Mechanical

Remington Rand UNIVAC is seeking a Flight Engineer with 5 years experience in the development of solid propellant rocket engines.

### Flight Testers—Mechanical

Remington Rand UNIVAC is seeking a Flight Tester with 5 years experience in the development of solid propellant rocket engines.

### Flight Engineers—General

Remington Rand UNIVAC is seeking a Flight Engineer with 5 years experience in the development of solid propellant rocket engines.

### Flight Testers—General

Remington Rand UNIVAC is seeking a Flight Tester with 5 years experience in the development of solid propellant rocket engines.

### Flight Engineers—Electrical

Remington Rand UNIVAC is seeking a Flight Engineer with 5 years experience in the development of solid propellant rocket engines.

### Flight Testers—Electrical

Remington Rand UNIVAC is seeking a Flight Tester with 5 years experience in the development of solid propellant rocket engines.

### Flight Engineers—Mechanical

Remington Rand UNIVAC is seeking a Flight Engineer with 5 years experience in the development of solid propellant rocket engines.

### Flight Testers—Mechanical

Remington Rand UNIVAC is seeking a Flight Tester with 5 years experience in the development of solid propellant rocket engines.

### Flight Engineers—General

Remington Rand UNIVAC is seeking a Flight Engineer with 5 years experience in the development of solid propellant rocket engines.

### Flight Testers—General

Remington Rand UNIVAC is seeking a Flight Tester with 5 years experience in the development of solid propellant rocket engines.

### Flight Engineers—Electrical

Remington Rand UNIVAC is seeking a Flight Engineer with 5 years experience in the development of solid propellant rocket engines.

### Flight Testers—Electrical

Remington Rand UNIVAC is seeking a Flight Tester with 5 years experience in the development of solid propellant rocket engines.

### Flight Engineers—Mechanical

Remington Rand UNIVAC is seeking a Flight Engineer with 5 years experience in the development of solid propellant rocket engines.

### Flight Testers—Mechanical

Remington Rand UNIVAC is seeking a Flight Tester with 5 years experience in the development of solid propellant rocket engines.

### Flight Engineers—General

Remington Rand UNIVAC is seeking a Flight Engineer with 5 years experience in the development of solid propellant rocket engines.

### Flight Testers—General

Remington Rand UNIVAC is seeking a Flight Tester with 5 years experience in the development of solid propellant rocket engines.

### Flight Engineers—Electrical

Remington Rand UNIVAC is seeking a Flight Engineer with 5 years experience in the development of solid propellant rocket engines.

### Flight Testers—Electrical

Remington Rand UNIVAC is seeking a Flight Tester with 5 years experience in the development of solid propellant rocket engines.

### Flight Engineers—Mechanical

Remington Rand UNIVAC is seeking a Flight Engineer with 5 years experience in the development of solid propellant rocket engines.

### Flight Testers—Mechanical

Remington Rand UNIVAC is seeking a Flight Tester with 5 years experience in the development of solid propellant rocket engines.

### Flight Engineers—General

Remington Rand UNIVAC is seeking a Flight Engineer with 5 years experience in the development of solid propellant rocket engines.

### Flight Testers—General

Remington Rand UNIVAC is seeking a Flight Tester with 5 years experience in the development of solid propellant rocket engines.

### Flight Engineers—Electrical

Remington Rand UNIVAC is seeking a Flight Engineer with 5 years experience in the development of solid propellant rocket engines.

### Flight Testers—Electrical

Remington Rand UNIVAC is seeking a Flight Tester with 5 years experience in the development of solid propellant rocket engines.

### Flight Engineers—Mechanical

Remington Rand UNIVAC is seeking a Flight Engineer with 5 years experience in the development of solid propellant rocket engines.

### Flight Testers—Mechanical

Remington Rand UNIVAC is seeking a Flight Tester with 5 years experience in the development of solid propellant rocket engines.

### Flight Engineers—General

Remington Rand UNIVAC is seeking a Flight Engineer with 5 years experience in the development of solid propellant rocket engines.

### Flight Testers—General

Remington Rand UNIVAC is seeking a Flight Tester with 5 years experience in the development of solid propellant rocket engines.

### Flight Engineers—Electrical

Remington Rand UNIVAC is seeking a Flight Engineer with 5 years experience in the development of solid propellant rocket engines.

### Flight Testers—Electrical

Remington Rand UNIVAC is seeking a Flight Tester with 5 years experience in the development of solid propellant rocket engines.

### Flight Engineers—Mechanical

Remington Rand UNIVAC is seeking a Flight Engineer with 5 years experience in the development of solid propellant rocket engines.

### Flight Testers—Mechanical

Remington Rand UNIVAC is seeking a Flight Tester with 5 years experience in the development of solid propellant rocket engines.

### Flight Engineers—General

Remington Rand UNIVAC is seeking a Flight Engineer with 5 years experience in the development of solid propellant rocket engines.

### Flight Testers—General

Remington Rand UNIVAC is seeking a Flight Tester with 5 years experience in the development of solid propellant rocket engines.

### Flight Engineers—Electrical

Remington Rand UNIVAC is seeking a Flight Engineer with 5 years experience in the development of solid propellant rocket engines.

### Flight Testers—Electrical

Remington Rand UNIVAC is seeking a Flight Tester with 5 years experience in the development of solid propellant rocket engines.

### Flight Engineers—Mechanical

Remington Rand UNIVAC is seeking a Flight Engineer with 5 years experience in the development of solid propellant rocket engines.

### Flight Testers—Mechanical

Remington Rand UNIVAC is seeking a Flight Tester with 5 years experience in the development of solid propellant rocket engines.

### Flight Engineers—General

Remington Rand UNIVAC is seeking a Flight Engineer with 5 years experience in the development of solid propellant rocket engines.

### Flight Testers—General

Remington Rand UNIVAC is seeking a Flight Tester with 5 years experience in the development of solid propellant rocket engines.

### Flight Engineers—Electrical

Remington Rand UNIVAC is seeking a Flight Engineer with 5 years experience in the development of solid propellant rocket engines.

### Flight Testers—Electrical

Remington Rand UNIVAC is seeking a Flight Tester with 5 years experience in the development of solid propellant rocket engines.

### Flight Engineers—Mechanical

Remington Rand UNIVAC is seeking a Flight Engineer with 5 years experience in the development of solid propellant rocket engines.

### Flight Testers—Mechanical

Remington Rand UNIVAC is seeking a Flight Tester with 5 years experience in the development of solid propellant rocket engines.

### Flight Engineers—General

Remington Rand UNIVAC is seeking a Flight Engineer with 5 years experience in the development of solid propellant rocket engines.

### Flight Testers—General

Remington Rand UNIVAC is seeking a Flight Tester with 5 years experience in the development of solid propellant rocket engines.

### Flight Engineers—Electrical

Remington Rand UNIVAC is seeking a Flight Engineer with 5 years experience in the development of solid propellant rocket engines.

### Flight Testers—Electrical

Remington Rand UNIVAC is seeking a Flight Tester with 5 years experience in the development of solid propellant rocket engines.

### Flight Engineers—Mechanical

Remington Rand UNIVAC is seeking a Flight Engineer with 5 years experience in the development of solid propellant rocket engines.

### Flight Testers—Mechanical

Remington Rand UNIVAC is seeking a Flight Tester with 5 years experience in the development of solid propellant rocket engines.

### Flight Engineers—General

Remington Rand UNIVAC is seeking a Flight Engineer with 5 years experience in the development of solid propellant rocket engines.

### Flight Testers—General

Remington Rand UNIVAC is seeking a Flight Tester with 5 years experience in the development of solid propellant rocket engines.

### Flight Engineers—Electrical

Remington Rand UNIVAC is seeking a Flight Engineer with 5 years experience in the development of solid propellant rocket engines.

### Flight Testers—Electrical

Remington Rand UNIVAC is seeking a Flight Tester with 5 years experience in the development of solid propellant rocket engines.

### Flight Engineers—Mechanical

Remington Rand UNIVAC is seeking a Flight Engineer with 5 years experience in the development of solid propellant rocket engines.

### Flight Testers—Mechanical

Remington Rand UNIVAC is seeking a Flight Tester with 5 years experience in the development of solid propellant rocket engines.

### Flight Engineers—General

Remington Rand UNIVAC is seeking a Flight Engineer with 5 years experience in the development of solid propellant rocket engines.

### Flight Testers—General

Remington Rand UNIVAC is seeking a Flight Tester with 5 years experience in the development of solid propellant rocket engines.

### Flight Engineers—Electrical

Remington Rand UNIVAC is seeking a Flight Engineer with 5 years experience in the development of solid propellant rocket engines.

### Flight Testers—Electrical

Remington Rand UNIVAC is seeking a Flight Tester with 5 years experience in the development of solid propellant rocket engines.

### Flight Engineers—Mechanical

Remington Rand UNIVAC is seeking a Flight Engineer with 5 years experience in the development of solid propellant rocket engines.

### Flight Testers—Mechanical

Remington Rand UNIVAC is seeking a Flight Tester with 5 years experience in the development of solid propellant rocket engines.

### Flight Engineers—General

Remington Rand UNIVAC is seeking a Flight Engineer with 5 years experience in the development of solid propellant rocket engines.

### Flight Testers—General

Remington Rand UNIVAC is seeking a Flight Tester with 5 years experience in the development of solid propellant rocket engines.

### Flight Engineers—Electrical

Remington Rand UNIVAC is seeking a Flight Engineer with 5 years experience in the development of solid propellant rocket engines.

### Flight Testers—Electrical

Remington Rand UNIVAC is seeking a Flight Tester with 5 years experience in the development of solid propellant rocket engines.

### Flight Engineers—Mechanical

Remington Rand UNIVAC is seeking a Flight Engineer with 5 years experience in the development of solid propellant rocket engines.

### Flight Testers—Mechanical

Remington Rand UNIVAC is seeking a Flight Tester with 5 years experience in the development of solid propellant rocket engines.

### Flight Engineers—General

Remington Rand UNIVAC is seeking a Flight Engineer with 5 years experience in the development of solid propellant rocket engines.

### Flight Testers—General

Remington Rand UNIVAC is seeking a Flight Tester with 5 years experience in the development of solid propellant rocket engines.

### Flight Engineers—Electrical

Remington Rand UNIVAC is seeking a Flight Engineer with 5 years experience in the development of solid propellant rocket engines.

### Flight Testers—Electrical

Remington Rand UNIVAC is seeking a Flight Tester with 5 years experience in the development of solid propellant rocket engines.

### Flight Engineers—Mechanical

Remington Rand UNIVAC is seeking a Flight Engineer with 5 years experience in the development of solid propellant rocket engines.

### Flight Testers—Mechanical

Remington Rand UNIVAC is seeking a Flight Tester with 5 years experience in the development of solid propellant rocket engines.

### Flight Engineers—

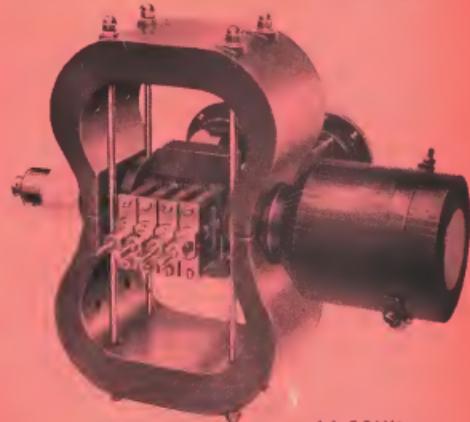




VA-834B amplifier klystron  
—1 kW CW—rugged  
—lightweight—for

**tactical  
mobility**

In Forward  
Scatter Transmitters



4.4 - 5.0 kMc  
1 kW CW

Need a rugged power amplifier tube for transportable microwave field equipment? Varian's VA-834B klystron is air-cooled and permanent-magnet focused. Simplifies operation and minimizes prime power requirements. Quick and easy to install. Only adjustment necessary — just tune to desired frequency. Tunable 4.4 to 5.0 kMc with 1 kW CW output. Lightweight — only 60 lb. including magnet.

Specifically developed for tactical and transportable equipment. Suited to commercial forward-scatter communications and radar transmitters.

#### FEATURES ■ 1 kW CW ■ 4.4 to 5.0 kMc

■ Efficiency up to 40% ■ 45 db Gain ■ 7.5 Mc Bandwidth

Sound interesting? We'll be pleased to send you full technical data. Just write Tube Division.

**VARIAN** associates

PALO ALTO 22, CALIFORNIA

BOMAC LABORATORIES, INC.  
VARIAN ASSOCIATES OF CANADA, LTD.  
S-F-D LABORATORIES, INC.  
SEMICON ASSOCIATES, INC.  
SEMICON OF CALIFORNIA, INC.  
VARIAN A. G. (SWITZERLAND)

